

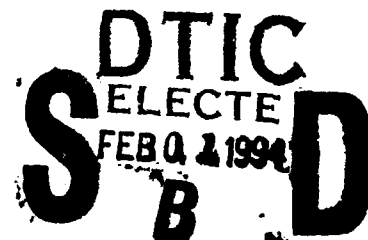
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**VALIDATION AND SENSITIVITY ANALYSIS
OF TEXAS HUMAN THERMAL MODEL
PREDICTIONS DURING COLD WATER
IMMERSION**

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INTRODUCTION

The US Navy is currently developing prototype garment ensembles which will provide integrated protection against chemical agents, hyperthermia, hypothermia, hypobaria and high-acceleration forces. As part of the development process, these garments must be tested to determine their ability to provide such integrated protection. As a supplement to manikin and human subject testing, mathematical modeling can be used to simulate thermal conditions considered too hazardous for human testing. It can also be used to establish guidelines on the amounts of clothing insulation necessary to permit exposures based on USN requirements.

The following document reports on studies using the Texas Human Thermal Model⁹ (referred to as the Model, below). This effort has included three tasks. The first involved translating and modifying the original FORTRAN program to operate in the Macintosh Programmer's Workshop environment and to allow computations involving extremely low CLO values. The second task was to validate Model performance by comparing its predictions to human rectal (T_{re}) and skin (T_{sk}) temperature measurements obtained during cold water immersions (CWI). In the third phase, a sensitivity analysis of the Model parameters pertaining to CWI survival scenarios was performed.

I. PROGRAM MODIFICATIONS

A. Program Description

The following description is detailed in the Model documentation provided by its author, Dr. Eugene H. Wissler of the University of Texas at Austin¹⁰. The Model is a one-dimensional transient-state model which computes thermal, cardiovascular, respiratory and metabolic changes that occur during a selected period of time, given initial values for all dependent variables and specification of independent variables. The human form is divided into 15 major segments including head, chest, abdomen and each leg and arm composed of three segments each. The following variables are computed at ten second intervals for each segment:

Time-dependent computed variables¹⁰:

- Temperatures at 15 radial points within each of the 15 body elements;
- Arterial and venous blood temperatures within each element;
- Local perfusion rate at each radial node;
- Metabolic rate at each node owing to resting metabolism, exercise and shivering;
- Oxygen, carbon dioxide and lactate concentrations in tissue and blood at each radial node;
- Regional rates of sweat production;
- Rate of sweat evaporation, which may be less than the rate of sweat secretion;
- Ventilation rate;
- Temperatures at up to six additional radial points within clothing;
- Amount of accumulated sweat at each clothing node;
- Rate of heat transfer between exposed surfaces and the environment owing to convection and radiation.

Specified parameters¹⁰:

- Subject weight and mean skinfold thickness, or regional subcutaneous fat thicknesses;
- Thermal resistance and permeability for water vapor of clothing on each body element;
- Resting and total metabolic rates (exclusive of shivering);
- Environmental conditions, including dry-bulb temperature, humidity, radiant flux and wind speed for a gas or temperature and fluid speed for a liquid.

B. Motivation

The Model required modifications for use in investigating thermal responses to CWI with clothing having wet CLO values below 0.1. For example, most of the current and prototype TacAir garments have such low wet CLO values. During the course of these programmatic changes a number of other enhancements were added.

C. Modifications

1. In order to implement these changes, the original FORTRAN code was translated into Language Systems FORTRAN® version 3.0, developed using the Macintosh Developers Workshop® (MPW) environment for use with the Apple Macintosh IIx™ computer (Language Systems Corporation, 441 Carlisle Drive, Herndon, VA 22070). The following were the changes required to operate in this environment.

- a. Logical units were changed so that inputs are handled through Unit 5, screen output through Unit 6 and printing through Unit 9.
- b. External file access now employs the standard Macintosh file input/output interface which permits the user to select the "Start" file of their choice. (The "Start" file specifies the data file names used during program execution). If file input/output errors occurred, a context-specific error message would be displayed to the user.
- c. Formatted outputs to files and for printing have been reconstructed to fit standard 8.5" x 11" portrait formatted sheets and now include headings logically describing the numerical data. All temperature outputs are now reported in Centigrade.

2. To increase code efficiency and readability, unused code segments and variables declared but not used were removed, thereby freeing memory resources. Relatively slow code structures, such as "IF-THEN-ELSE", were replaced with faster ones, such as "CASE SELECT." As a benchmark, modelling a 1 minute thermal exposure now requires 4 to 5 seconds of computational time which includes data output to the screen, (i.e. a 6 hour CWI can be modelled in about 29 minutes) an improvement of about 450%. Program code has been segregated into logical segments which are used by the Macintosh Memory Manager to load/unload resources as necessary. This increased memory use efficiency. The program has been extensively commented, with descriptions of variables and module functions.

3. The original Model would continue to operate unless a predefined time limit was reached or arterial temperature reached 32.5°C. After 50% of the maximum aerobic capability of the modeled "human" was exhausted, the Model began anaerobic metabolism and lactic acid began to accumulate. This continued until the subject reached metabolic fatigue and shivering stopped. At this point, central (3rd element of the head segment), and arterial temperatures increased, causing a "hump" in these curves. All Model predictions at this point and beyond are unreliable. However, the program would continue computations beyond this point. Note that if a user only monitored rectal or mean skin temperature estimates, they would be unaware that fatigue had been reached. The Model has been modified to check for this rise in arterial temperature at which point it ceases computations and informs the user that the Model has "reached a metabolic fatigue limit." This check begins after arterial temperature drops to 35.5°C and was inserted into the code just prior to the 32.5°C check.

4. Each of the Model's body segments contained fifteen radial nodes which described the various physical properties associated with that segment. These radial nodes were further subdivided into eight segments each. The physical arrangement of these radial nodes was described by spacing variables associated with each of the property nodes. In its original form,

use of CLO values lower than 0.04 in the subroutine which determined the heat transfer coefficient values for immersion conditions ("SuitW") caused the program to enter an endless iteration loop. This was caused by the spacing variable "H(i,6)" becoming a negative value. H(i,6) refers to the sixth segment of the i^{th} radial node (where $i = 1$ to 15). To fix this problem, two modifications were required. First, a test was done for CLO values equal to or less than 0.029. If this was the case, then clothing type was changed to "NUDE" and computations were performed using the "NUDE" section in SuitW. If CLO = 0.03, then H(i,6) was set equal to its absolute value (0.0000044) and allow processing to continue in the "THIN" section of subroutine SuitW. ("Thin" refers to a Thinsulate dry suit for use during immersion in water). These changes provided results consistent with theoretical projections of the Model and manikin CLO data results.

5. The subroutine which determined garment parameters in gas environments is called "SuitG." The program has a series of garments which are predefined in subroutines SuitW and SuitG. For example, it was not easy to predict the degree of thermal loading associated with wearing anti-exposure garments in a warm environment. In the case in which a garment was not previously defined, SuitG will now check for garment information as defined in SuitW. If a match is not found, then a suit definition file can be chosen through the standard Macintosh input/output interface window.

6. It was found that if a scenario was constructed in which a subject would undergo two or more different conditions during the same run that certain inconsistencies would arise. Similar problems would also arise when running multiple independent exposures. These effects would be propagated through the next portion of the scenario and bias the results. The code now includes the subroutine "INIT" in which all necessary variables are reset to their initial state prior to entering the next condition.

7. Various internal arrays and printing variables have been reformatted to increase the number of thermal and other parameters available as outputs from 75 to 120. An additional output data file has been created in which the user can select specific temperatures or other parameters to be saved in a format that can be easily and directly imported into Macintosh or DOS data analysis programs.

8. Future plans include modifying the user interface to conform to Apple Macintosh standards. This includes menu driven program selections, window input/output structures and Macintosh Event driven program structure in place of the traditional FORTRAN top-down format. Combined, these changes will improve user ability to run simulations and enter control variables from a single program. Currently a separate editor program must be used along with the Model itself.

Texas Human Thermal Model Validation Study

I. APPROACH

A working definition for human model "validation" is to determine if its mathematical predictions follow actual overall physiologic trends reasonably (e.g. relative changes over time are similar to actual data). In order to validate the Texas Human Thermal Model, thermal data obtained from human volunteers immersed in cold water were compared to Model predictions. This information, including subject weight, mean skinfold thickness and the environmental conditions, were obtained from four unrelated cold water survival garment assessments (Pelapu) performed by the Finnish Institute of Occupation Health. These were referred to below as P1³, P2⁴, P4⁵ and P5⁶. During these assessments, T_{re} and various skin temperatures were recorded using thermistors at 5, 10 or 15 minute intervals³⁻⁶. The first three studies lasted a maximum of six hours and the latter study lasted two hours. Immersions were terminated prematurely when hand or foot temperatures fell below 10°C, subjects complained of cold pain, cardiac irregularities occurred or if T_{re} fell below 35°C. Only two of the immersions were reported to have been terminated due to the latter condition. A total of 29 male and 13 female volunteers participated in these studies while wearing one of eleven different clothing ensembles.

These parameters and estimates of the garment CLO values^{1,7} were used by the Model to compute T_{re} and various body segment T_{sk} for a period identical to the actual subject's immersion time and output using the same sampling interval. These predictions were plotted, compared to the actual temperature data and statistical tests of significance were performed. Environmental conditions and subject physical characteristics were matched in the simulation as closely as possible.

Assumptions

1. It was assumed that the test subjects were relaxed, floating head-out in the cold water with their heads covered. For all simulation runs, the Model subject was placed in a relaxed sitting posture. Under these conditions, it was assumed that air temperature was not a factor. It was postulated that an exercise metabolic rate of 1 watt and a basal metabolic rate of 100 watt approximated the actual human rates. Relative humidity was 100% and air pressure was 760 torr (actual tests were conducted at sea level). Water temperatures and wind speed used in the Model matched the actual conditions.

2. Starting segment temperatures as predicted by the Model were very consistent for a given clothing ensemble regardless of the individual's physical characteristics. In fact, there was little flexibility that a user of the Model could employ to tailor these predictions to fit a particular set of human physical characteristics. While determinations of the "goodness of fit" of the predictions with respect to the actual data were conducted on the initial and final (end of CWI) temperatures, calculations based upon the relative change in temperature from the start of the CWI as well as the shape of the temperature curves over time were used to provide the best estimate of the "validity" of the Model.

3. The Model has only one "standard" human; which was male. As such, male and female data could only be treated the same - when statistical differences were demonstrated, such data were not pooled. For example, weight and mean skinfold thickness (MST) measurements were typically quite different between the sexes, with females displaying a higher MST than males.

4. Human temperatures were measured at specific spots on the skin whereas the Model computed a weighted distributed temperature based on the overall volume of a body segment (basically modeled as a cylinder). In the analysis below, it was assumed that these two temperatures were comparable.

5. Garment CLO values used in the simulation were from the US Navy CWU-62/P (for Gore-Tex Over Water Flight Suit - P5)¹ and the CWU-60/P⁷ ensemble (for all other anti-exposure suits) since the actual tested garment ensemble CLO values were not available. The 62/P was used since it is constructed of the same fabric as that used in P5. The 60/P was chosen because it is a closed cell neoprene dry suit with an attached hood and is constructed in a similar fashion to the suits used in P1, P2 and P4. It was assumed that these values were comparable to the actual suits tested.

II. ANALYSIS

A. For each data set, information was separated in terms of suit worn and sex of the subject for comparison purposes. Sex differences between subject responses and Model predictions were analyzed. In all cases, the following information was calculated or plotted:

1. Immersion time (minutes)
2. T_i : initial temperature ($^{\circ}\text{C}$)
3. T_{fn} : final temperature at end of immersion ($^{\circ}\text{C}$)
4. Difference between subject and Model T_i
5. Difference between subject and Model T_{fn}
6. Overall change in temperature ($T_{fn}-T_i$): ΔT
7. Plots of raw temperature data for human and Model data versus immersion time (t)
8. Plots of change in temperatures (adjusted so that at $t=0$, $T_i = 0$) for all human and Model data curves versus immersion time
9. Description of curve type and subjective assessment of curve morphological agreement
10. Model predicted an initial rise in T_{re} : a) time to peak, b) magnitude of peak, and c) duration of rise were measured
11. Slope of sigmoidal fall of T_{re} , calculated from the end of the initial rise (or the point at which temperature started falling if subject data had no peak) to beginning of the plateau (units of $^{\circ}\text{C}/\text{min}$)
12. For body segment temperatures exhibiting exponential declines upon immersion (e.g. thigh, abdomen): a) time was measured from the start to plateau (the first and last 10% of the overall value disregarded) and b) the associated drop in magnitude ($^{\circ}\text{C}$)
13. Means and standard deviations were computed with respect to suit type and gender for statistical analyses.

B. Statistical Analysis

Two way unpaired t-tests were performed to test the "goodness of fit" of Model predictions as well as to determine if some of the assumptions made were not statistically significant. These tests included comparisons of the mean actual and mean predicted initial temperatures, final temperatures and ΔT , slope of T_{re} and exponential characteristics of abdominal and thigh temperatures. Tests were performed to determine effects of suit type and sex (for P1, P2 and P4). Statistical significance was set at the 0.05 level. Tests were run using NCSS, version 5.0².

C. CLO Values

1. Model predictions for P1, P2 and P4 were run using immersed CLO values from the CWU-60/P or "Imperial" suit. P5 comparisons were performed using CWU-62/P (USN

anti-exposure ensemble with USAF helmet) CLO values. (The USAF helmet was the default helmet used in the Model). The CLO values were:

Suit:	Chest	Abdomen	Head	Arm	Hand	Leg	Foot
CWU-60/P	1.53	2.69	0.77	1.08	0.90	1.11	1.23
CWU-62/P	0.77	0.77	4.16	0.13	0.03	0.60	0.48

D. Human Data Set Description and Data Organization

1. P1:

This data set included T_{re} , abdominal (T_{abd}), hand (T_h) and foot (T_f) temperatures measured from fifteen males and six females during six hour CWI (see Table 1 for suits worn, physical characteristics and environmental conditions). Garment ensembles included the NORD 15 (nylon textile coated suit with neoprene), the Helly Hansen (polyurethane covered nylon textile), the Bayley Featherlite (closed cell Featherlite material), the Liukko (PVC coated 100% polyester cloth on both sides), the Imperial (5090 gm closed cell neoprene), the Fitz-Wright (5510 gm closed cell neoprene) and the URSUIT (4600 gm closed cell neoprene). Analysis of the ΔT_{re} , initial T_{re} and final T_{re} indicated that there was no statistical difference between the seven suits. Therefore, subject data was pooled regardless of suit type and organized for analysis into four groups: individuals completing a) 6 hour immersions (split into two subgroups of 5 males, P1-6m, and 5 females, P1-6f, each), b) 4 to 5 hours (4 males, P1-5) and c) 3 to 4 hours (4 males, P1-4). Two males (immersed less than 180 minutes) and one female (immersed 4 to 5 hours) were not included in the statistical analysis because they were significantly different from the others. Analysis of these individuals alone would have required three additional groups of one - insufficient power to perform statistical tests. Skin temperature of the extremities - back reaching 10°C (subjects 5,9,11,12,14,15,16,18,20), cold pain (subject 21) or heart beat irregularity (subject 10) were reasons for failure to complete the full six hours.

2. P2:

The P2 data set included T_{re} , T_h , T_f , thigh (T_t), arm (T_{am}), chest (T_c) and calf (T_{cf}) temperatures measured from five males and five females during six hour CWI (see Table 1). Garment ensembles included the closed cell neoprene URSUIT 5001 and RUKKA 8380. Analysis of the ΔT , T_i and T_{fm} indicated that for the male chest and female hand there were statistical differences between the suits. There were also some other isolated gender differences. Therefore, except for the aforementioned body segments, the data set was separated in terms of sex (males: P2-m; females: P2-f) and pooled in terms of suit type prior to comparisons between estimated and actual temperatures. It was not possible to further subdivide the subjects into groups based on total immersion times due to low numbers. Subjects 9, 10 and 11 completed their immersions, subjects 13, 14, 15 and 16 completed 5 hours, subject 17 completed 4 hours and subject 8 completed 3 hours. Those not finishing six hours ended their immersions due to subjective reasons.

3. P4:

This data set included T_{re} , T_{abd} , T_t , T_{am} , T_h , T_{cf} and shoulder (T_s) temperatures measured from three males and two females during six hour CWI while wearing a Bayley Immersion Suit (see Table 1). Foot temperature was also recorded, but thermistor probes failed for three of five subjects so data analysis did not include the feet. None of the subjects completed the total immersion period. Subjects 2, 3 and 4 ended their immersions due to cold foot pain while the other subjects were taken out of the water because their T_{re} reached 35°C.

Since the Model includes in its chest segment an area including the shoulder, these two temperatures were compared. Except for the actual final and ΔT of hand temperatures and starting arm temperature, there were no statistically significant differences based on sex. Therefore, except for these instances, data was pooled prior to data processing.

4. P5:

T_{re} , T_{abd} , T_b , T_{cf} and T_f measured from six males during two hour CWI while wearing a Gore-Tex Over Water Flight Suit were included in P5 (see Table 1). Only subject 6 completed two hours while the others completed between one and two hours and ended their runs due to subjective reasons. Subject data was pooled for statistical analysis.

III. DATA

A. Physical characteristics of the subjects and the environment are given in Table 1. Tables of actual and predicted temperatures and ΔT are given in Appendix A. Tabular data is expressed as a mean \pm one standard deviation.

P1: 6 hour maximum immersion

Subj No.	Group	Sex	Suit	Weight (lb)	MST (mm)	Water Temp. (°F)	Immersion Time (min)
1	P1-6m	M	F-W	152.12	8.65	31.5	360
3	P1-6m	M	B	141.10	9.25	31.5	360
13	P1-6m	M	B	167.55	12.25	31.0	360
6	P1-6m	M	N15	138.89	8.40	31.5	360
8	P1-6m	M	I	154.32	14.65	31.3	360
2	P1-6f	F	H-H	156.53	19.50	31.6	360
17	P1-6f	F	H-H	149.91	10.58	31.3	360
5	P1-6f	F	B	167.55	22.68	31.3	360
7	P1-6f	F	N15	152.12	19.75	31.6	360
19	P1-6f	F	U	119.05	9.93	31.6	360
4	P1-5	M	L	163.14	11.10	31.6	255
10	P1-5	M	I	145.51	8.20	31.6	270
15	P1-5	M	N15	160.94	15.60	31.0	300
16	P1-5	M	U	152.12	10.63	31.6	255
9	P1-4	M	H-H	180.78	11.50	31.0	210
14	P1-4	M	I	185.19	11.90	30.5	210
18	P1-4	M	F-W	165.35	8.18	31.3	195
21	P1-4	M	L	154.32	10.80	30.5	210
11		F	F-W	163.14	16.14	31.3	240
20		M	L	182.98	14.23	31.3	165
12		M	U	145.51	8.45	30.5	135

TABLE 1. Summary of human subject physical characteristics and environmental conditions. MST = mean skinfold thickness. (F-W: Fitz-Wright, H-H: Helly Hanson, B: Bayley, L: Liukko, N15: Nord 15, I: Imperial, U: Ursuit)

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P2: 6 hour maximum immersion

Subj No.	Suit	Sex	Weight (lb)	MST (mm)	Water Temp. (°F)	Immersion Time (min)
8	U	F	136.69	11.60	31.4	180
9	U	F	132.28	9.80	31.4	360
12	U	M	198.42	9.08	31.4	330
14	U	F	138.89	15.43	31.4	300
16	U	M	206.13	10.30	31.4	300
10	R	M	153.22	5.13	31.4	360
11	R	M	213.85	13.03	31.4	360
13	R	F	132.28	10.60	31.4	300
15	R	F	136.69	14.60	31.4	300
17	R	M	166.45	10.20	31.4	240

(U: Ursuit 5001, R: Rukka 8380)

P4: 6 hour maximum immersion

Subj No.	Suit	Sex	Weight (lb)	MST (mm)	Water Temp. (°F)	Immersion Time (min)
1	B	M	162.80	7.70	32.0	200
2	B	F	138.60	13.30	32.0	300
3	B	M	169.40	7.95	32.0	300
4	B	M	215.60	13.03	32.0	300
5	B	F	118.80	8.05	32.0	300

(B: Bayley immersion suit)

P5: 2 hour maximum immersion

Subj No.	Suit	Sex	Weight (lb)	MST (mm)	Water Temp. (°F)	Immersion Time (min)
1	G	M	136.84	6.68	32.0	95
2	G	M	170.50	7.43	32.0	105
3	G	M	155.98	6.68	32.0	70
4	G	M	155.32	5.30	32.0	80
5	G	M	176.44	7.48	32.0	105
6	G	M	170.50	4.68	32.0	120

(G: Gore-Tex Over Water Flight Suit)

TABLE 1 (con'd). Summary of human subject physical characteristics and environmental conditions. MST = mean skinfold thickness.

IV. RESULTS

A. Rectal Temperature

Model predictions indicated that there would be an initial rise in T_{re} , caused by peripheral vasoconstriction, to a peak followed by an sigmoidal drop to a plateau. The Model

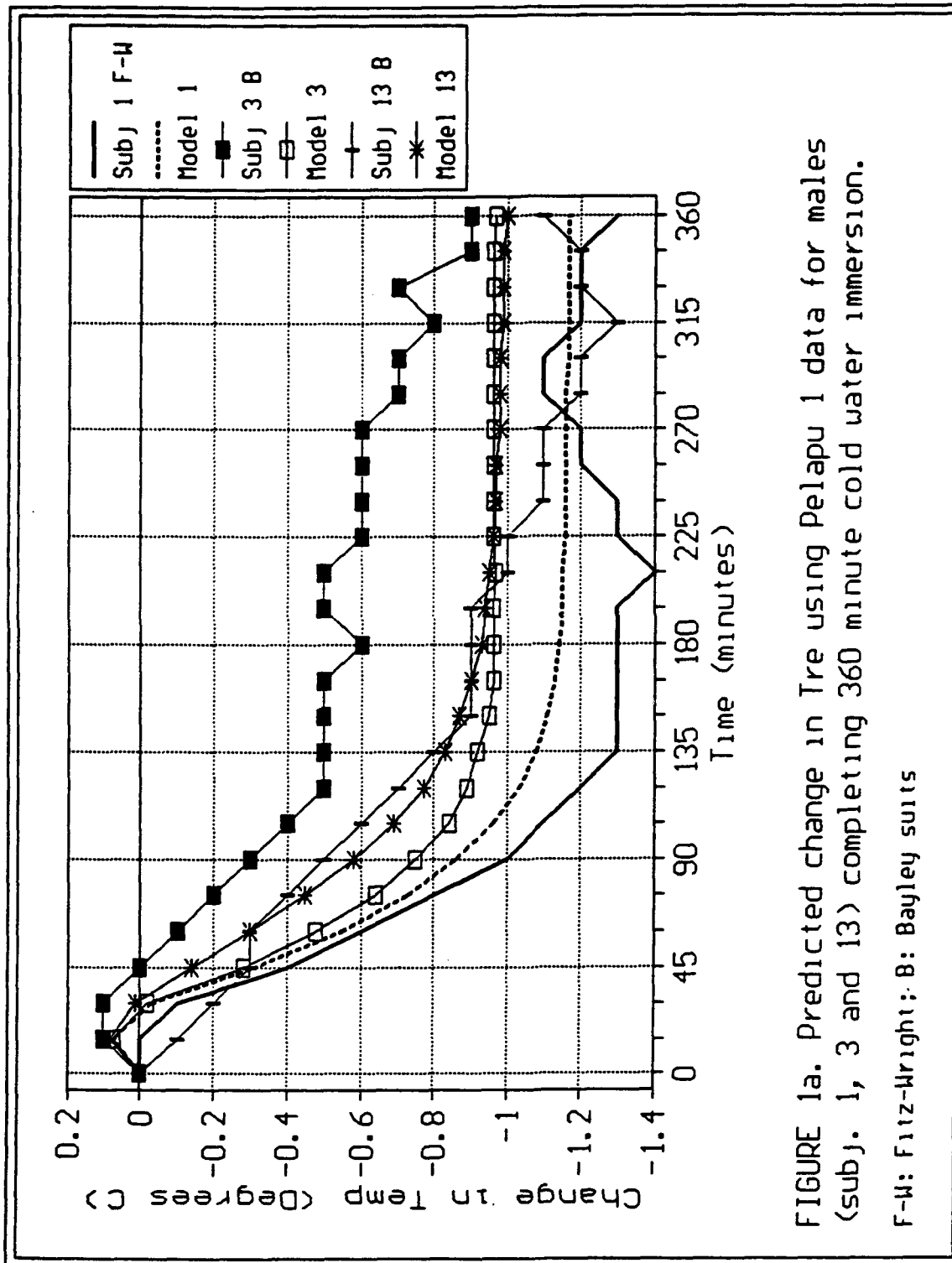
always predicted a starting T_{re} of 37.0°C regardless of conditions. T_{re} and results of statistical comparisons are found in Table 2. Comparisons between actual and estimated T_{re} are shown in Figures 1-9. In these figures, starting T_{re} is normalized to zero and temperatures are expressed as a change in °C with respect to the beginning of the immersion.

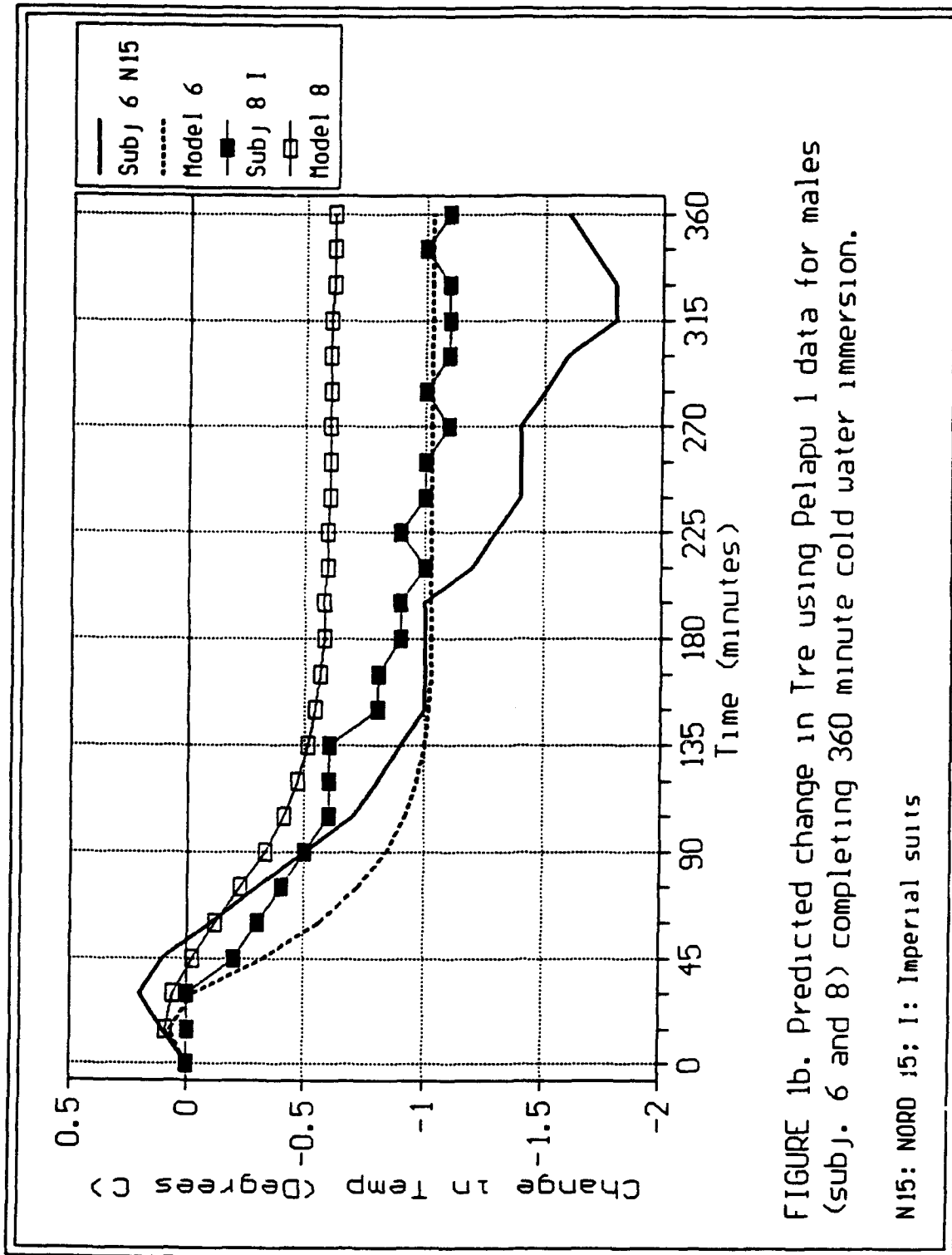
Only sixteen members of the subject pool exhibited the initial rise in T_{re} as predicted (P1: 5 males, 1 female; P2: 2 males, 3 females; P4: 1 male; P5: 4 males). The timing and extent of this rise did follow predictions except for P5. In P5, the actual peripheral vasoconstriction response lasted longer than predicted (55.0 ± 29.6 (Ts: subject response) vs 21.7 ± 4.1 min (Tm: predicted response)).

Actual initial T_{re} was higher than predicted for all groups, though the difference was only significant for P1 and P2 females. Final T_{re} Model estimates were consistently lower than actual T_{re} , though the differences were not significant except for groups P1-4 and P5. In general, Model estimates of T_{re} tended to be conservative and predicted a cooler T_{re} by the end of the immersion period. However, Model still provided a very good prediction of the drop in core temperature given that differences between actual and estimated T_{re} slopes and ΔT_{re} were not significant for groups P1, P2 and P4. Model did not provide good estimates of ΔT_{re} for P5 by predicting a steeper decline (slope) in T_{re} than was seen in the actual data (See Figure 9).

Subjective assessment of the overall curve shapes of the actual and estimated temperatures using ΔT_{re} plots also indicated a reasonable agreement for P1 and P2 (see Figures 5 and 6). In data set P4, the actual data exhibited a fairly linear drop to a plateau rather than a sigmoidal decline as predicted by the Model. While the Model predictions for the shape of the P5 T_{re} curves were good, the difference in duration periods of the initial rise in T_{re} may account for the poorer Model predictions for P5 despite the similarity between the predicted and actual curves.

For P1 and P2, no significant differences between actual male and female T_{re} was found. However, Model predictions of final T_{re} , ΔT_{re} and slope were different when P1-6m and P1-6f were compared. The Model predicted that females would have a smaller ΔT_{re} ($p=0.012$), more gradual slope ($p=0.034$) and a much longer initial peak duration as compared to males (average predicted male peak duration was 31.7 ± 5 min vs 92.5 ± 61.8 min for females). Similarly, the Model predicted a smaller overall drop in T_{re} for P2 females than males ($p<0.000$). However, the actual P2 ΔT_{re} were not different ($p=0.484$). Also, Model predictions of T_{re} slopes were significantly different ($p=0.025$) while the human data were comparable ($p=0.807$). There were individual subject differences, particularly with respect to gender in data set P4 (see Figures 7 and 8). Estimated T_{re} for male P4 subjects followed actual data more closely than for the P4 females. For example, the difference between actual and estimated T_{re} for female P4 subject 2 was much larger than the male subjects (up to 0.6°C below estimates as compared to the males whose estimated T_{re} were within $\pm 0.2^\circ\text{C}$ with respect to actual values over the first 110 minutes).





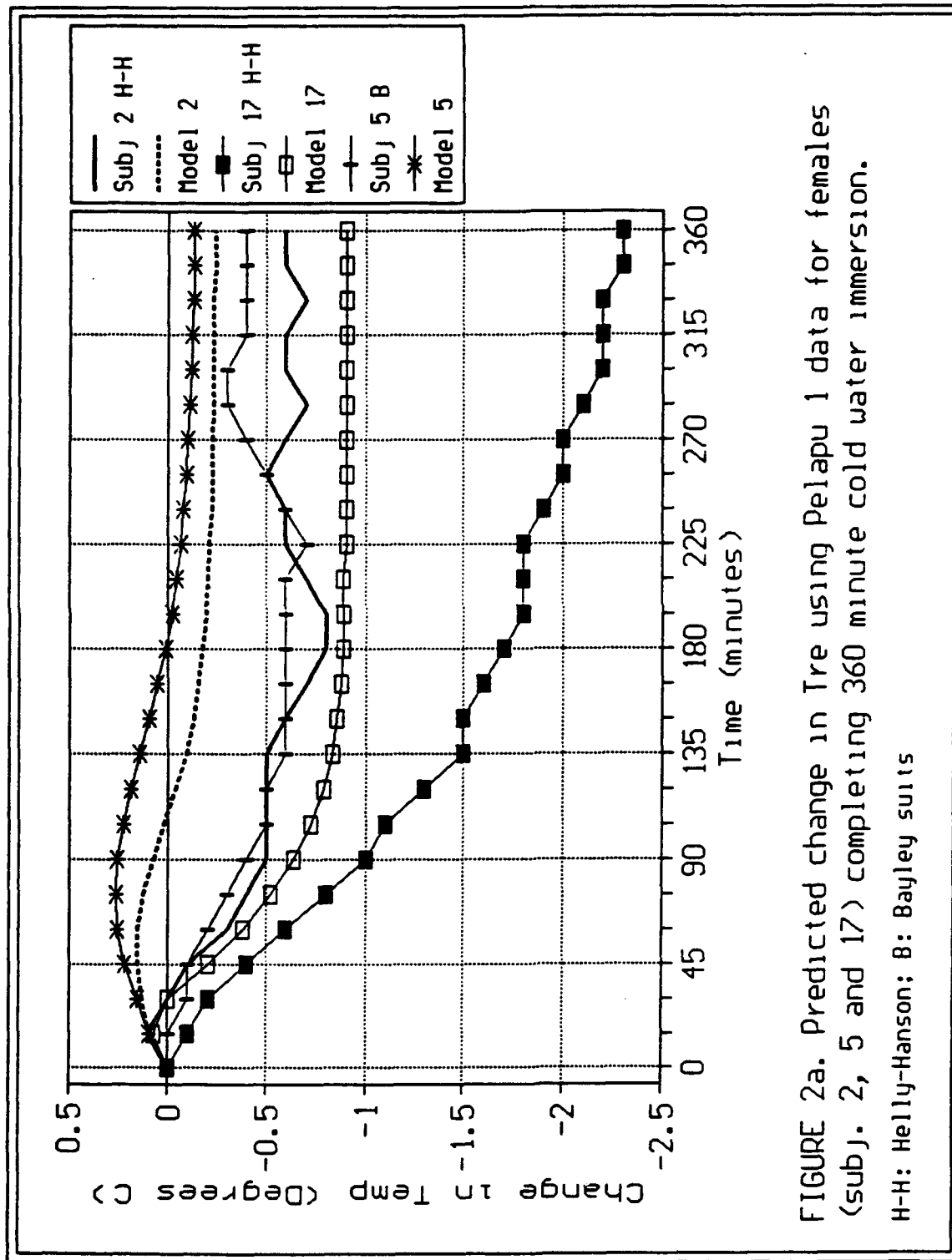
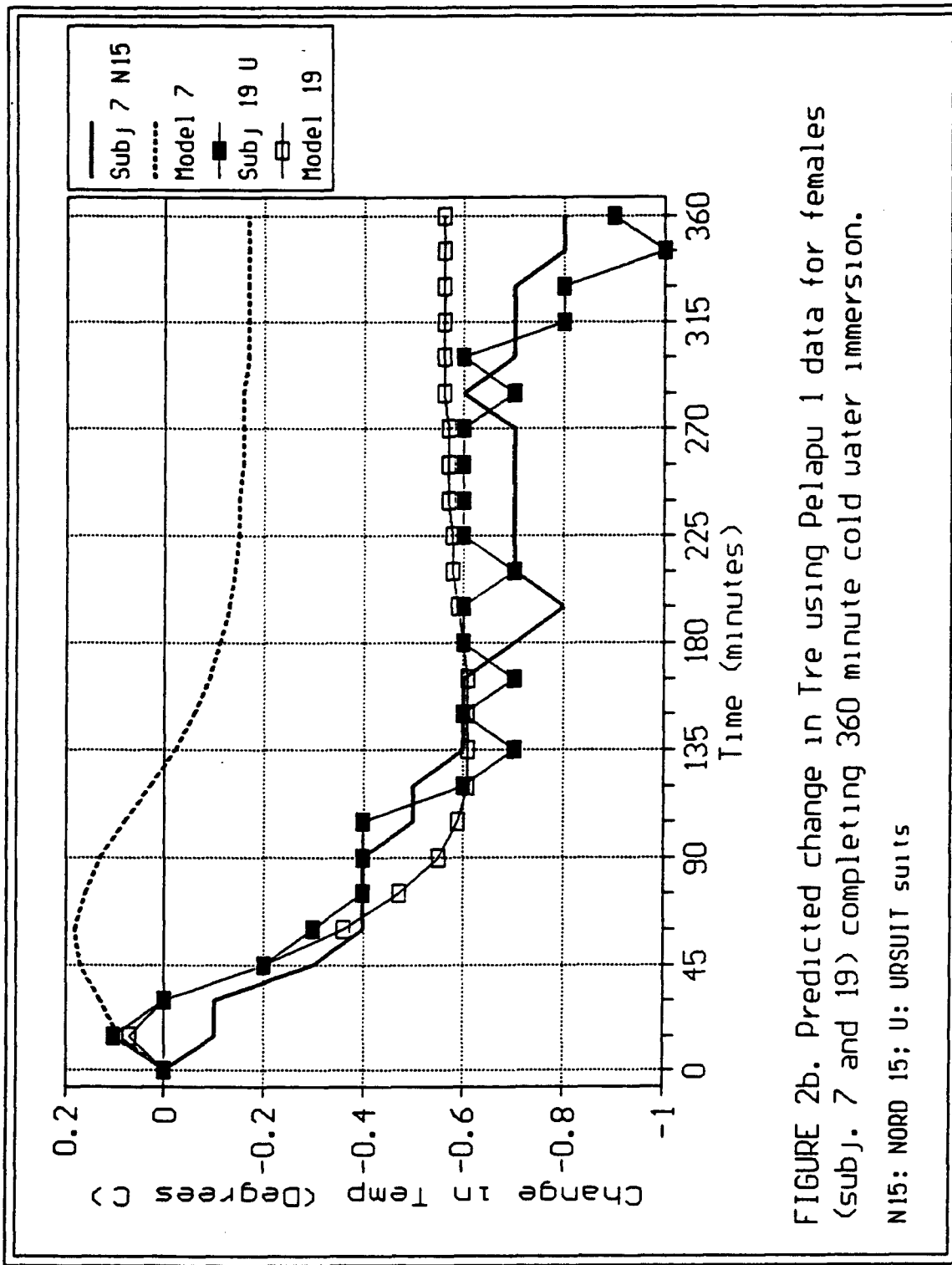
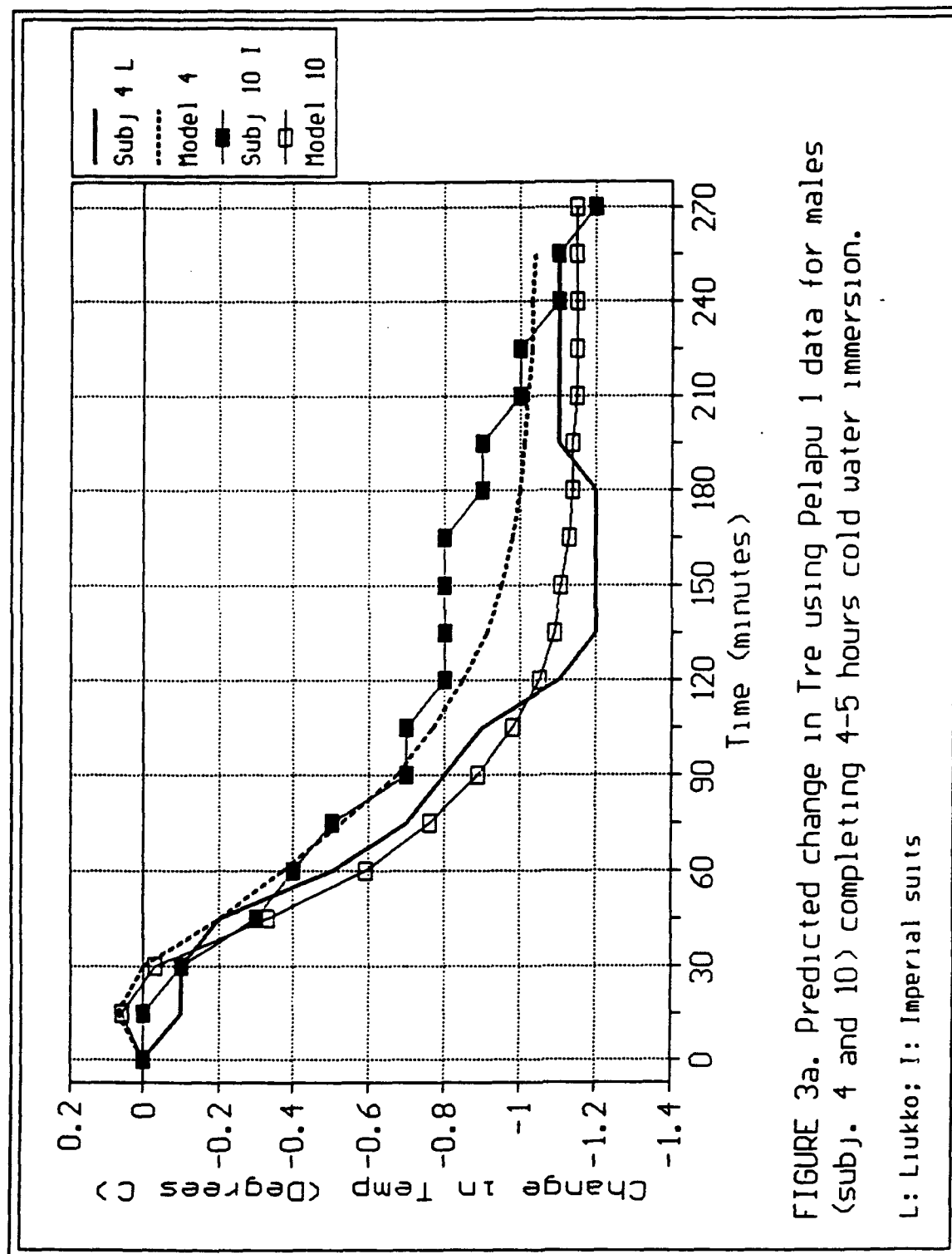
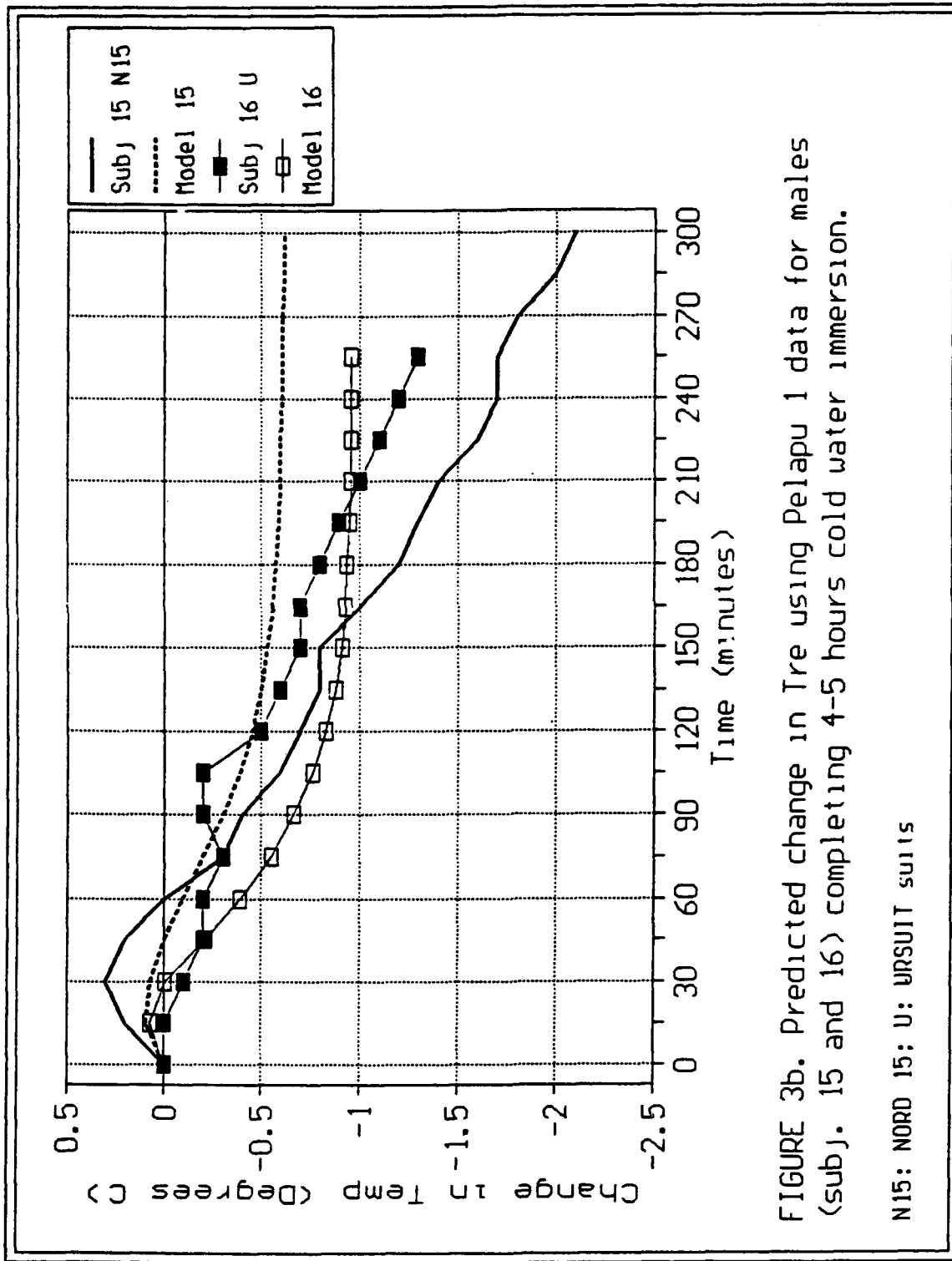


FIGURE 2a. Predicted change in T_{re} using Pelapu 1 data for females (subj. 2, 5 and 17) completing 360 minute cold water immersion.

H-H: Helly-Hanson; B: Bayley suits







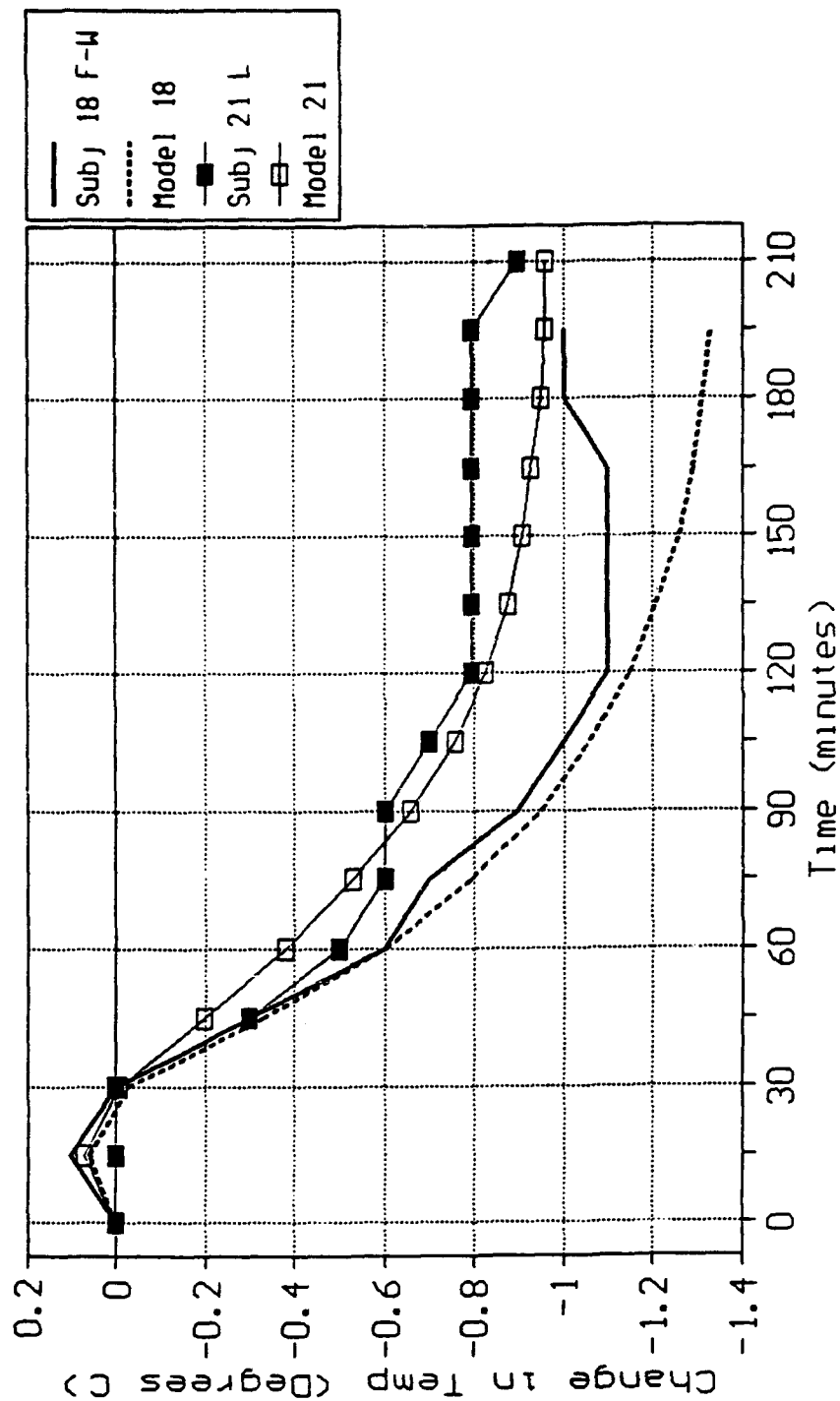


FIGURE 4a. Predicted change in Tre using Pelapu 1 data for males (subj. 18 and 21) completing 3-4 hours cold water immersion.

F-W: Fitz-Wright; L: Liukko suits

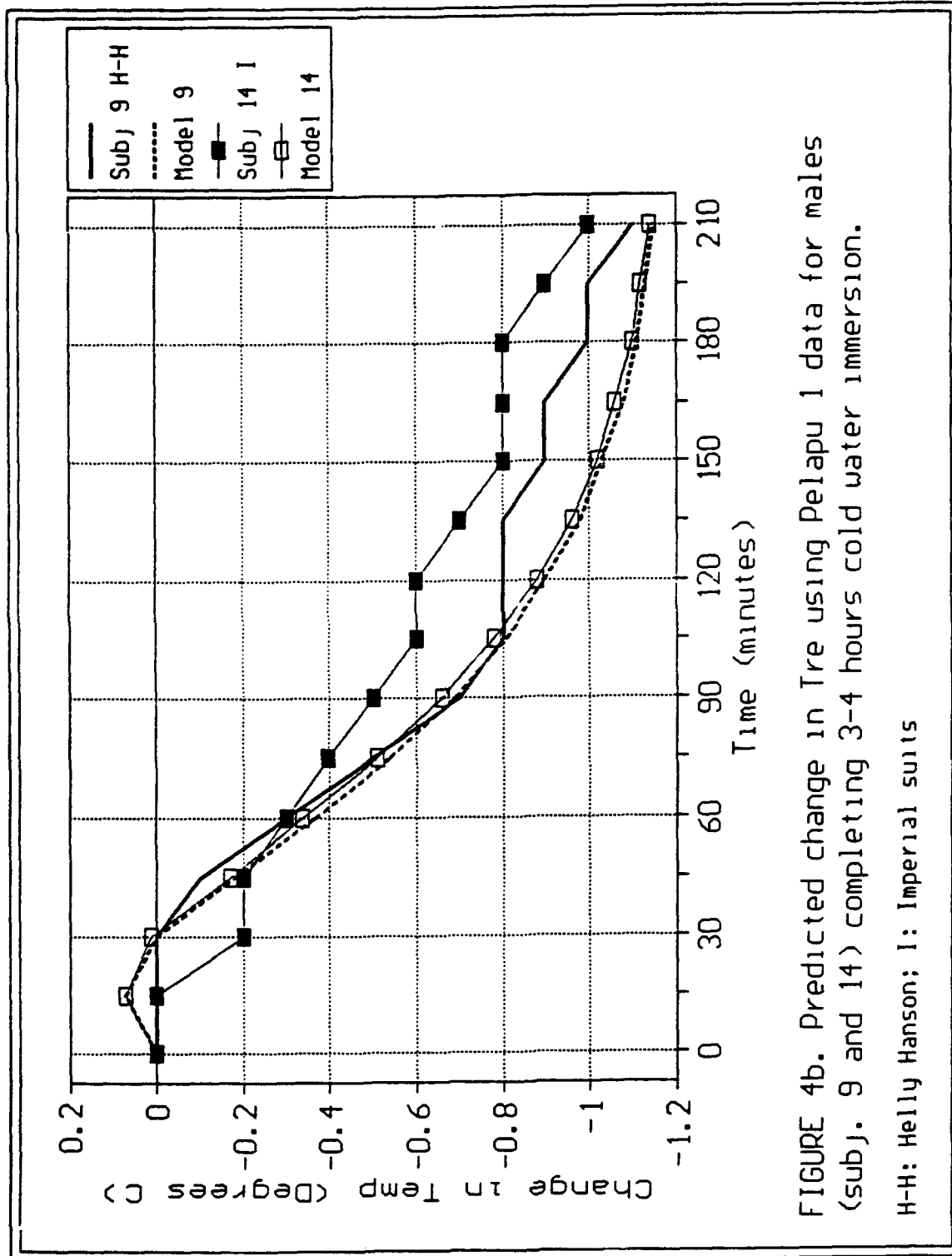


FIGURE 4b. Predicted change in Tre using Pelapu 1 data for males (subj. 9 and 14) completing 3-4 hours cold water immersion.

H-H: Helly Hanson; I: Imperial suits

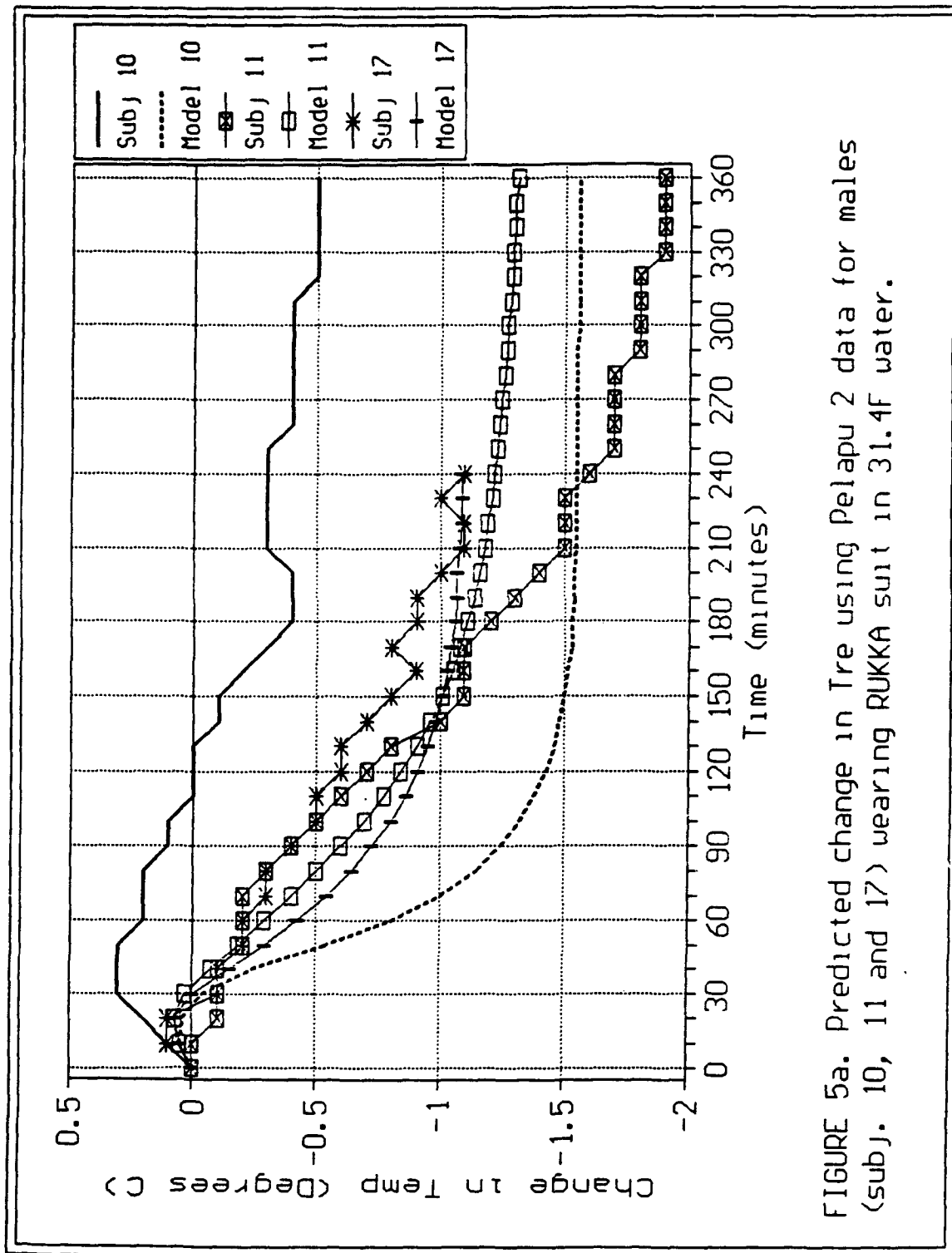


FIGURE 5a. Predicted change in Tre using Pelapu 2 data for males (subj. 10, 11 and 17) wearing RUKKA suit in 31.4F water.

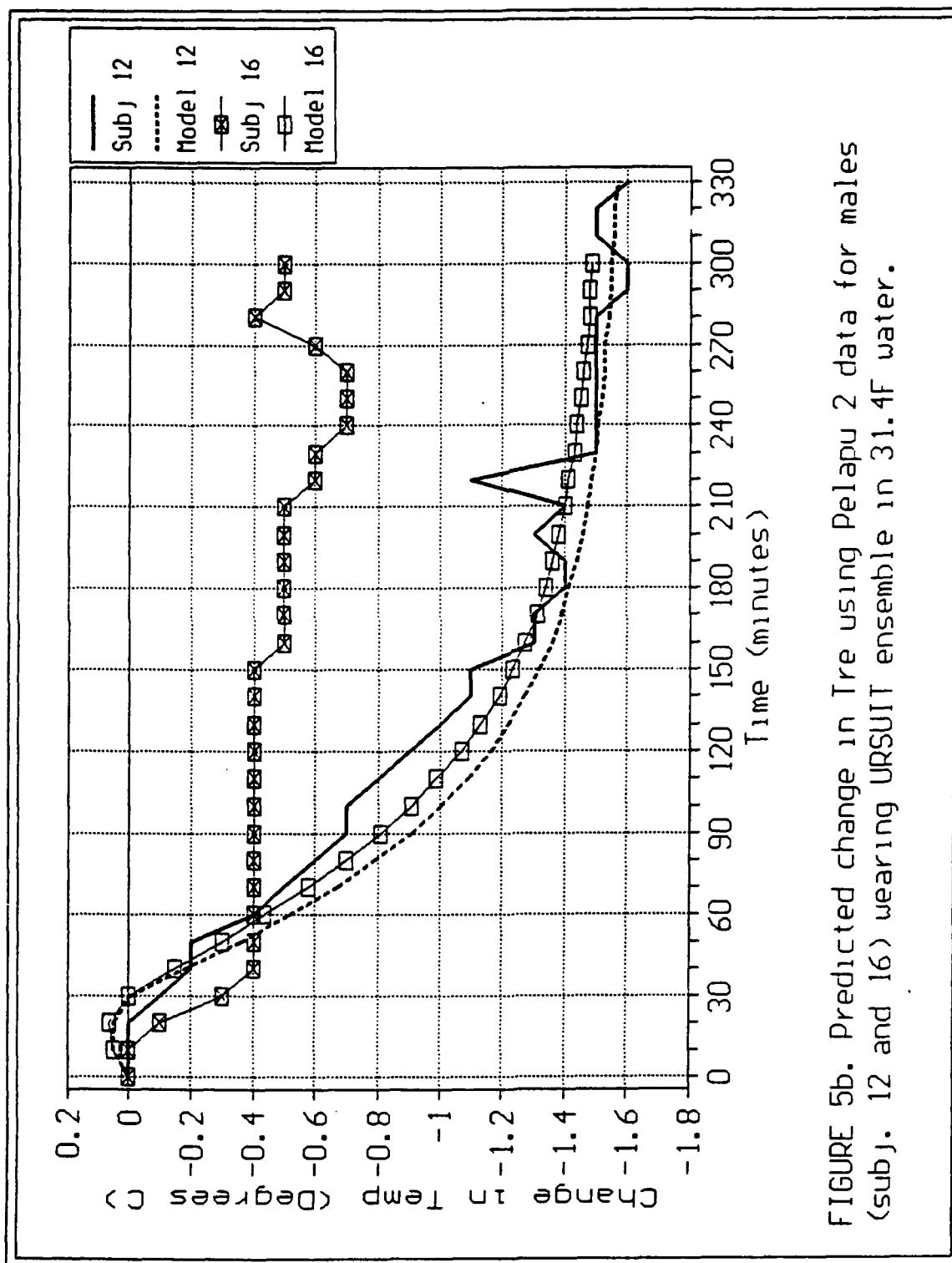


FIGURE 5b. Predicted change in Tre using Pelapu 2 data for males (subj. 12 and 16) wearing URSUIT ensemble in 31.4F water.

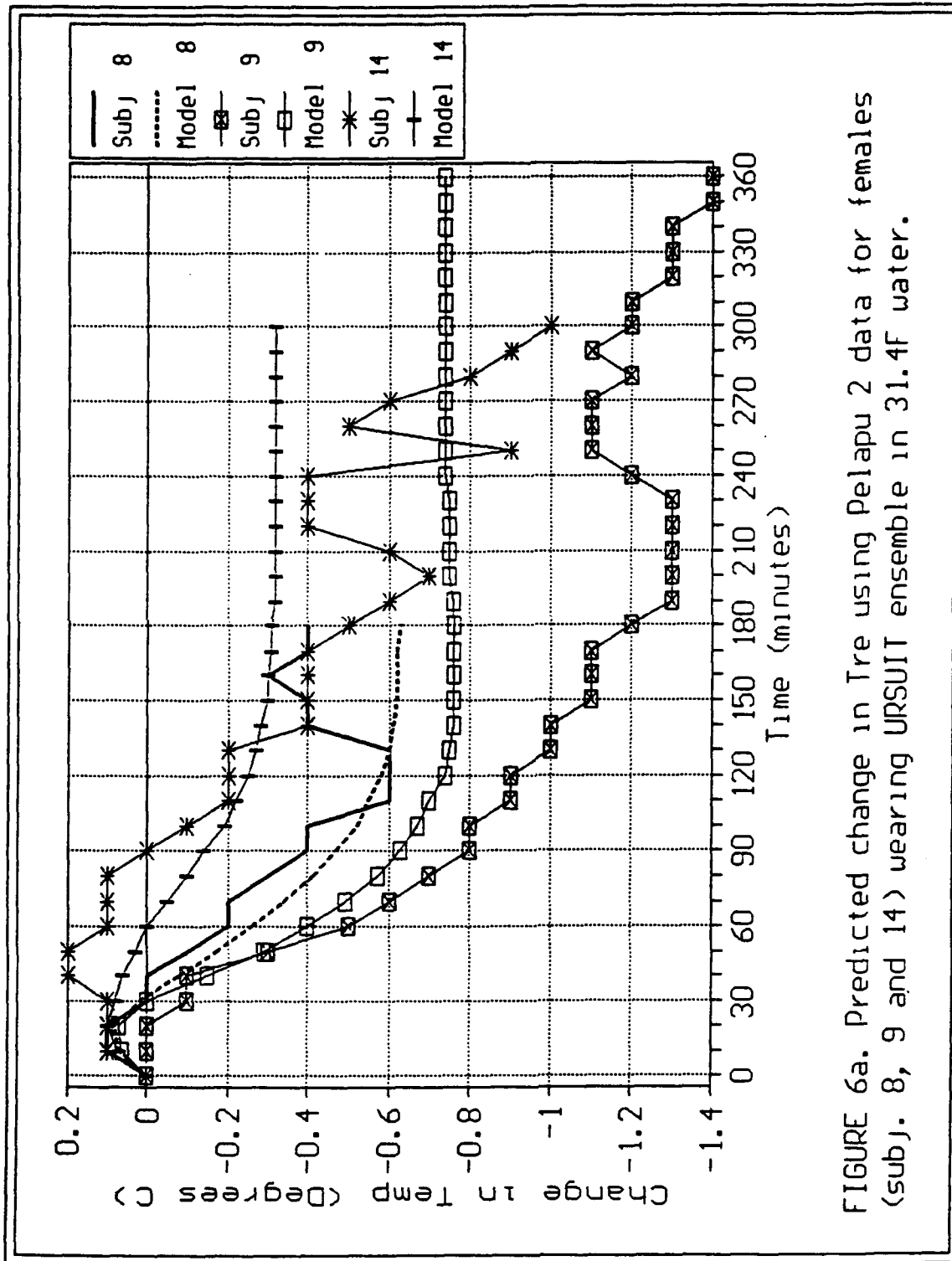


FIGURE 6a. Predicted change in Tre using Pelapu 2 data for females (subj. 8, 9 and 14) wearing URSUIT ensemble in 31.4F water.

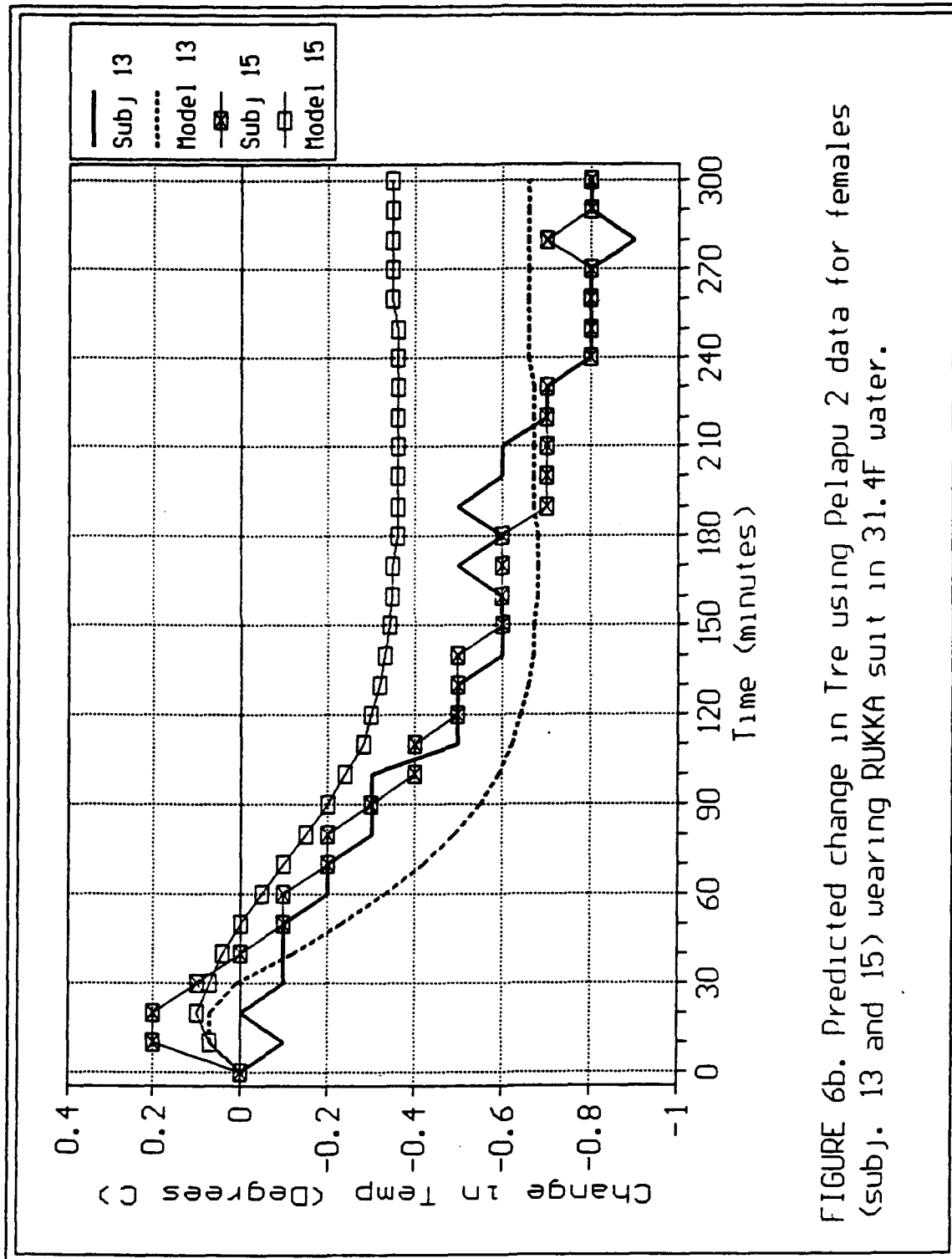


FIGURE 6b. Predicted change in Tre using Pelapu 2 data for females (subj. 13 and 15) wearing RUKKA suit in 31.4F water.

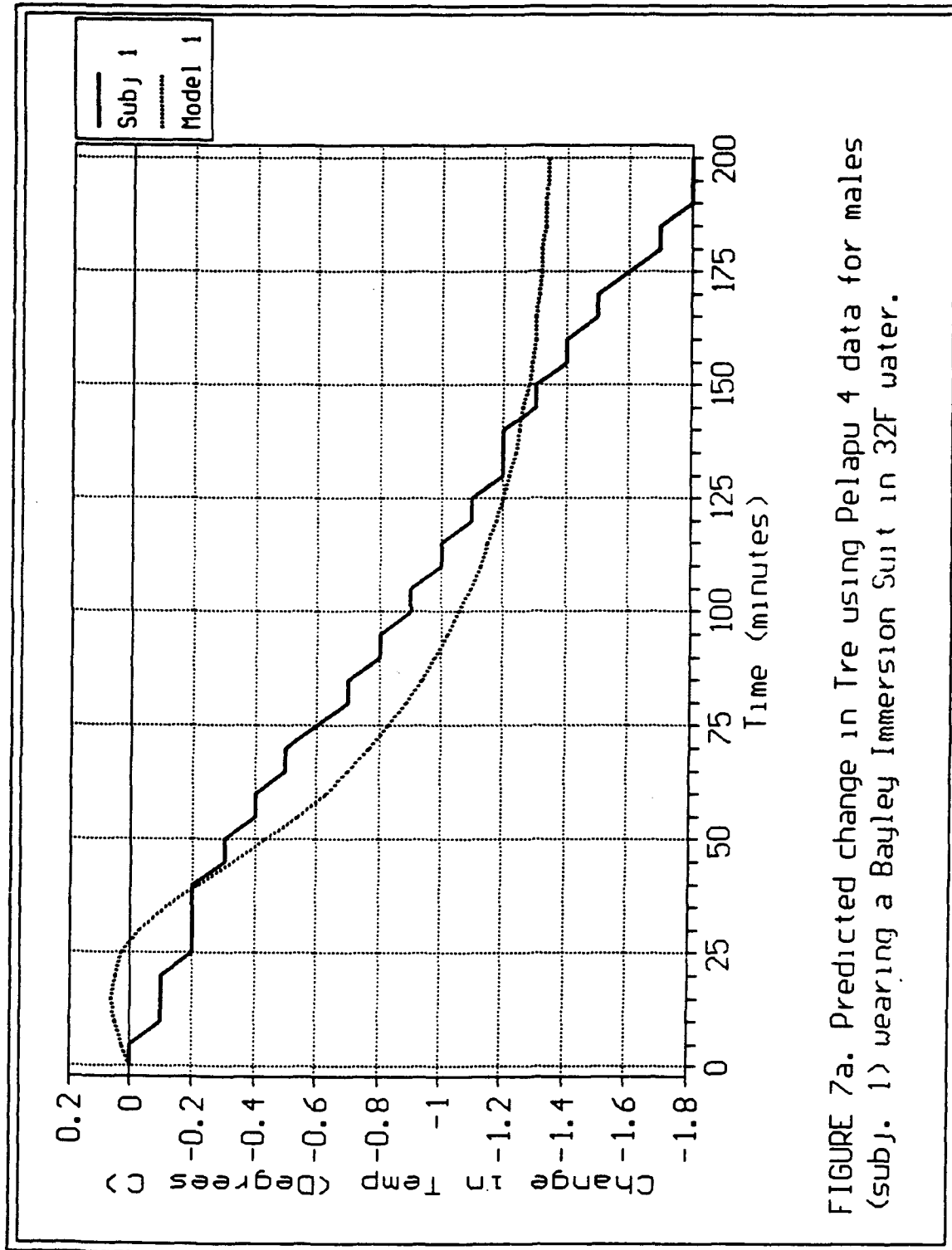


FIGURE 7a. Predicted change in Tre using Pelapu 4 data for males (subj. 1) wearing a Bayley Immersion Suit in 32F water.

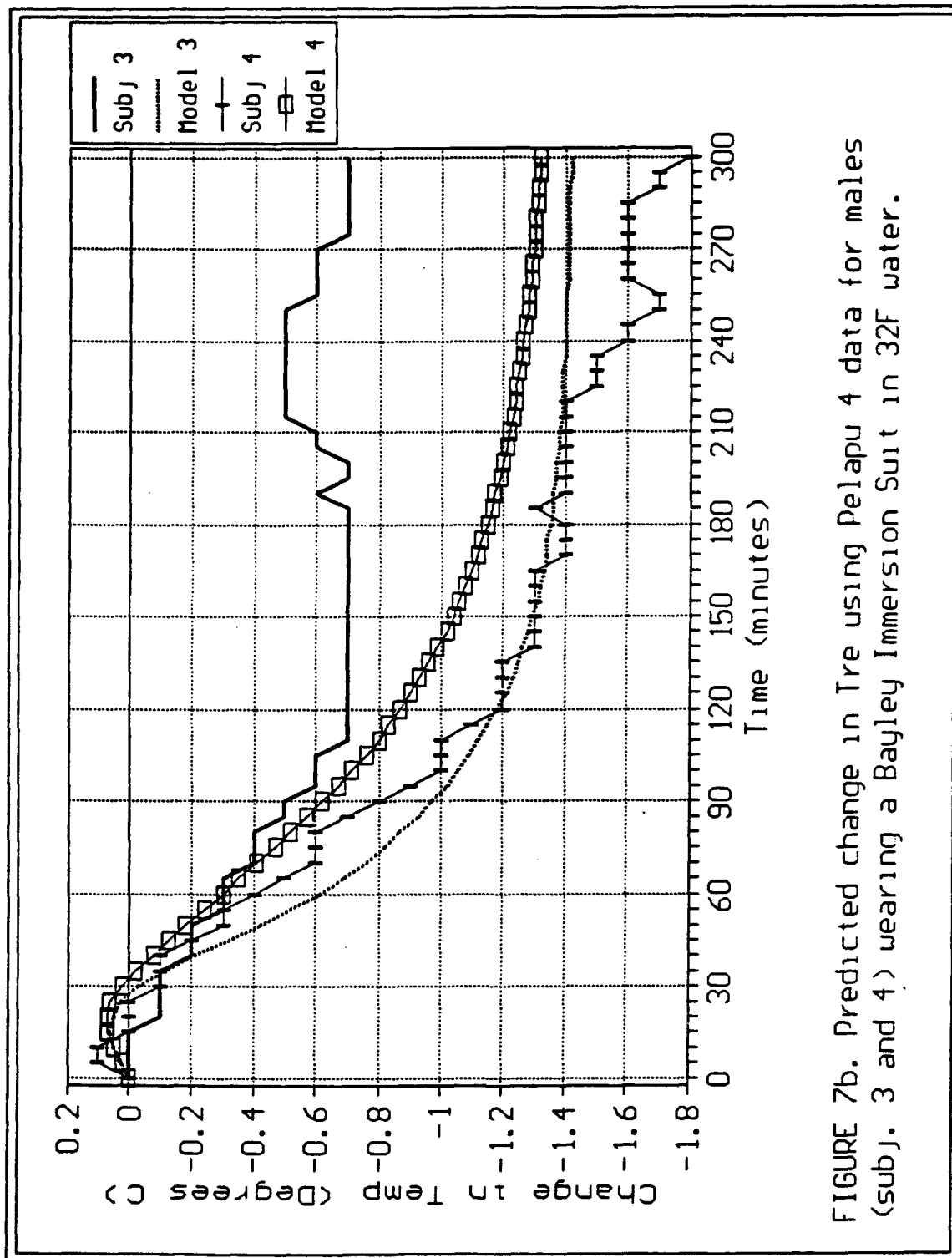


FIGURE 7b. Predicted change in Tre using Pelapu 4 data for males (subj. 3 and 4) wearing a Bayley Immersion Suit in 32F water.

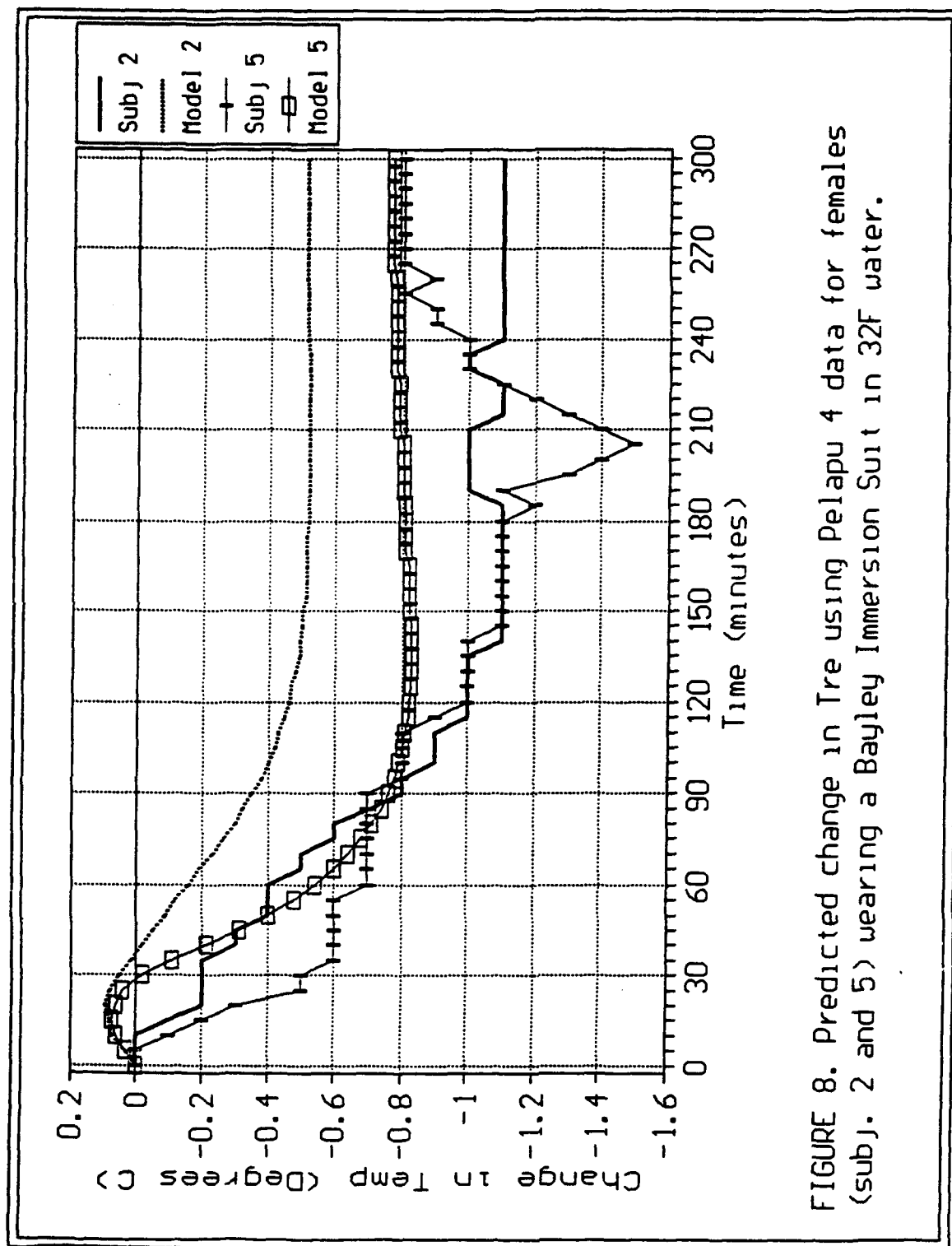


FIGURE 8. Predicted change in Tre using Pelapu 4 data for females (subj. 2 and 5) wearing a Bayley Immersion Suit in 32F water.

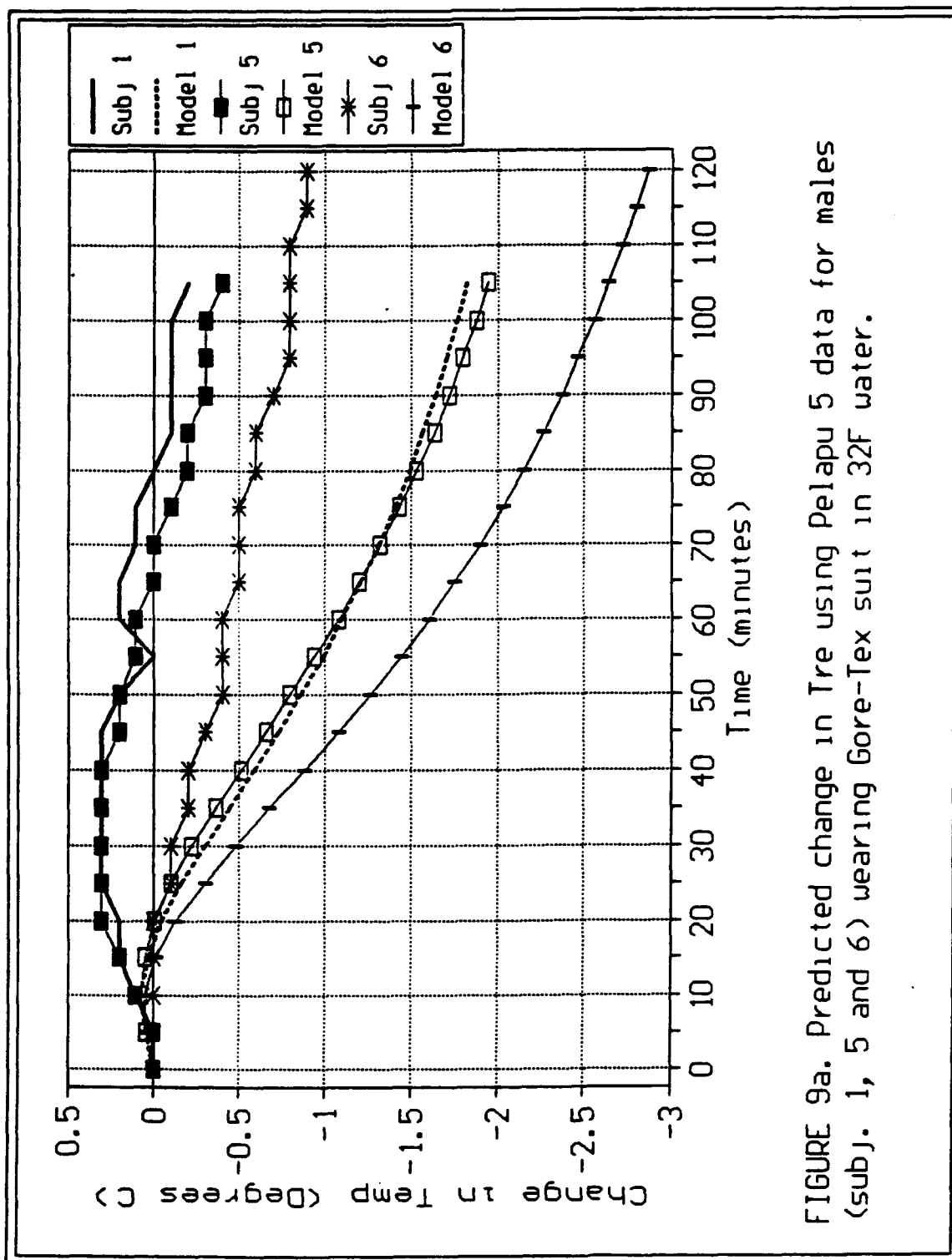


FIGURE 9a. Predicted change in Tre using Pelapu 5 data for males (subj. 1, 5 and 6) wearing Gore-Tex suit in 32F water.

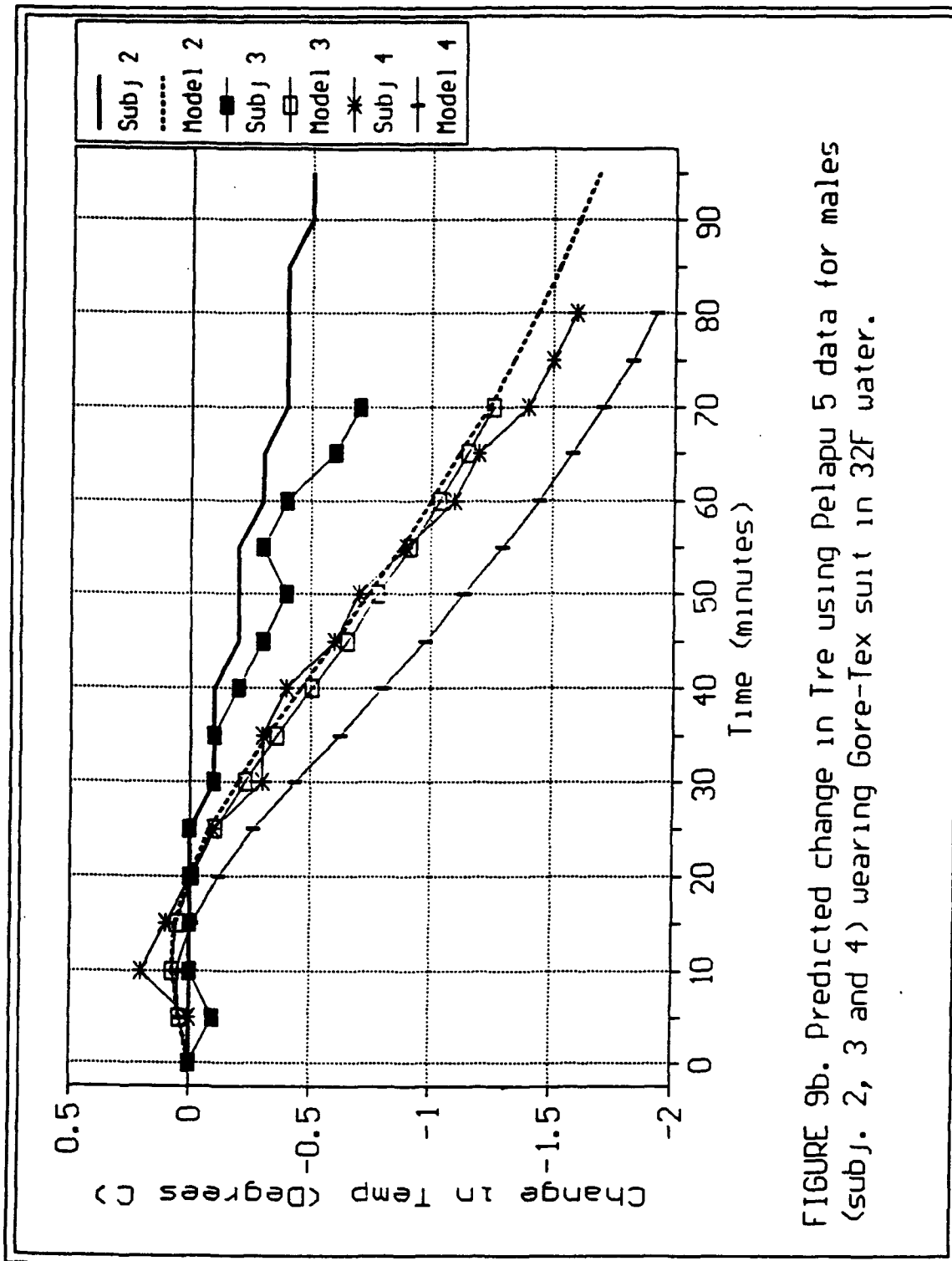


FIGURE 9b. Predicted change in Tre using Pelapu 5 data for males (subj. 2, 3 and 4) wearing Gore-Tex suit in 32F water.

Subject Group	Mean Initial T_{re}			Mean Final T_{re}		
	Actual	Estimated	p	Actual	Estimated	p
P1-6m	37.5 \pm 0.4	37.0 \pm 0.0	0.047	36.3 \pm 0.5	36.1 \pm 0.2	0.410
P1-6f	37.8 \pm 0.2	37.0 \pm 0.0	0.001	36.8 \pm 0.7	36.6 \pm 0.3	0.662
P1-5	37.7 \pm 0.1	37.0 \pm 0.0	0.000	36.3 \pm 0.3	36.1 \pm 0.2	0.342
P1-4	37.5 \pm 0.2	37.0 \pm 0.0	0.009	36.5 \pm 0.1	35.9 \pm 0.2	0.001
P2-m	37.4 \pm 0.4	37.0 \pm 0.0	0.082	36.3 \pm 0.6	35.6 \pm 0.2	0.064
P2-f	37.3 \pm 0.2	37.0 \pm 0.0	0.014	36.4 \pm 0.4	35.5 \pm 0.2	0.882
P4	37.3 \pm 0.4	37.0 \pm 0.0	0.180	36.1 \pm 0.9	35.9 \pm 0.4	0.793
P5	37.1 \pm 0.3	37.0 \pm 0.0	0.777	36.3 \pm 0.4	35.1 \pm 0.5	0.001

Subject Group	Mean ΔT_{re}			Mean T_{re} Slope		
	Actual	Estimated	p	Actual	Estimated	p
P1-6m	-1.20 \pm 0.27	-0.96 \pm 0.21	0.144	-0.008 \pm 0.003	-0.009 \pm 0.002	0.711
P1-6f	-1.00 \pm 0.75	-0.04 \pm 0.33	0.153	-0.007 \pm 0.003	-0.004 \pm 0.003	0.218
P1-5	-1.43 \pm 0.46	-0.94 \pm 0.23	0.108	-0.008 \pm 0.002	-0.008 \pm 0.002	0.752
P1-4	-1.00 \pm 0.08	-1.15 \pm 0.15	0.142	-0.009 \pm 0.003	-0.010 \pm 0.001	0.571
P2-m	-1.12 \pm 0.63	-1.40 \pm 0.20	0.384	-0.006 \pm 0.003	-0.010 \pm 0.003	0.066
P2-f	-0.88 \pm 0.36	-0.54 \pm 0.19	0.101	-0.006 \pm 0.001	-0.006 \pm 0.001	0.822
P4	-1.24 \pm 0.53	-1.07 \pm 0.41	0.590	-0.008 \pm 0.002	-0.011 \pm 0.003	0.105
P5	-0.72 \pm 0.50	-1.92 \pm 0.53	0.002	-0.012 \pm 0.008	-0.025 \pm 0.004	0.007

TABLE 2. Comparison of actual vs Model estimated rectal temperature ($^{\circ}\text{C}$). Values given are ± 1 standard deviation, p = two-way unpaired t-test probability.

B. Abdomen Temperature (T_{abd})

Model predictions indicated that T_{abd} would drop exponentially to a plateau during CWI. After reaching that plateau, T_{abd} slightly rose (typically no more than 0.5°C). The Model predicted a starting T_{abd} of 34.8°C under all tested conditions. T_{abd} and results of statistical comparisons are found in Table 3. Overall, no gender-based statistical differences were demonstrated.

Actual T_{abd} curves were similar to those predicted for P4 and four of the six P5 subjects. In data set P1, only those subjects wearing the Fitz-Wright suit demonstrated exponential declines in T_{abd} . The change in magnitude and time required to reach the plateau portion of the curves (calculated from the point at which initial T_{abd} dropped by 10% to 10% above the plateau value, whether the fall was exponential or not) was compared between actual and Model estimates. The Model predicted a significantly larger drop in T_{abd} than was actually exhibited by the subjects for each group except P1-4. For P4, the estimated time to reach plateau was similar to the actual (68.8 ± 18.9 (Ts) vs 82.4 ± 20.1 min (T_m), $p=0.302$). However, for P5,

the estimated rate of decline was significantly faster than actual T_{abd} (-0.12 ± 0.09 (T_s) vs $-0.24 \pm 0.04^\circ\text{C}/\text{min}$ (T_m), $p=0.015$).

Subject Group	Mean Initial T_{abd}			Mean Final T_{abd}		
	Actual	Estimated	p	Actual	Estimated	p
P1-6m	32.2 ± 1.3	34.8 ± 0.0	0.011	30.5 ± 1.6	29.8 ± 1.0	0.411
P1-6f	31.8 ± 1.5	34.8 ± 0.0	0.011	27.9 ± 5.2	28.2 ± 1.8	0.897
P1-5	33.0 ± 0.8	34.8 ± 0.0	0.022	32.4 ± 1.1	29.5 ± 1.0	0.007
P1-4	31.0 ± 1.5	34.8 ± 0.0	0.015	26.5 ± 1.9	29.5 ± 0.6	0.041
P4	33.7 ± 1.4	34.8 ± 0.0	0.151	31.5 ± 2.9	29.9 ± 1.1	0.289
P5	34.6 ± 1.4	34.8 ± 0.0	0.933	29.0 ± 3.7	24.3 ± 0.9	0.003

Subject Group	Mean ΔT_{abd}			Magnitude of Exponential T_{abd} Drop		
	Actual	Estimated	p	Actual	Estimated	p
P1-6m	-1.7 ± 0.7	-5.0 ± 0.3	0.000	-2.0 ± 1.2	-4.3 ± 0.7	0.015
P1-6f	-4.0 ± 4.0	-6.5 ± 1.8	0.240	-2.6 ± 0.9	-5.5 ± 1.5	0.050
P1-5	-0.6 ± 1.8	-5.2 ± 1.0	0.004	-2.2 ± 0.8	-4.3 ± 0.7	0.009
P1-4	-4.5 ± 3.3	-5.3 ± 0.6	0.678	-2.8 ± 0.9	-4.3 ± 0.6	0.063
P4	-2.2 ± 2.0	-4.8 ± 1.1	0.023	-2.3 ± 0.9	-4.1 ± 0.8	0.011
P5	-5.6 ± 2.8	-10.2 ± 0.9	0.009	-4.2 ± 2.2	-8.0 ± 0.6	0.013

TABLE 3. Comparison of actual vs Model estimated abdomen temperature ($^\circ\text{C}$). Values given are ± 1 standard deviation, p = two-way unpaired t-test probability.

While the Model predicted a small increase in T_{abd} once the plateau had been reached, actual human T_{abd} responses were highly variable, often including temperature oscillations, and many subjects had a rather large increase in T_{abd} instead of a stable plateau value. For example, subject 21 (in group P1-4) had a unique 10°C drop in T_{abd} during the last 15 minutes in the water while T_{abd} for subjects 10 (in group P1-5), 3 and 5 (group P4) 3 and 4 (group P5) rose by about 1 to 3°C after reaching plateau. It was possible that these subjects may have had more air trapped in the torso of their outfits than the others or they were not as completely relaxed as was assumed.

Actual starting T_{abd} was cooler than the predicted in all groups (the difference was significant for P1). Final temperature predictions were valid for P1 subjects finishing six hour CWI and for group P4. The Model consistently overestimated ΔT_{abd} for most of the data sets, though there was considerable subject variability. For example, P1 subject 21 (in group P1-4) had a unique 10°C drop in T_{abd} during the last 15 minutes in the water and P1 subject 10's T_{abd} (in group P1-5) fell and then recovered to starting temperature by the end of his run.

C. Hand Temperature (T_h)

According to Model predictions, T_h exhibited a simple second order decline in

magnitude. This characteristic curve shape was remarkably consistent regardless of the Model inputs. Starting T_h was typically 32.7°C. Hand temperatures and results of statistical comparisons are found in Table 4.

For groups P1, P2 and P4, actual T_h demonstrated a linear or second order fall which was similar to the predicted curves. However, the Model consistently overestimated starting T_h (though the difference was only significant for P1-6 and P1-4) and, except for P1-5, significantly underestimated the final T_h .

There were individual suit-based differences in final T_h and in ΔT_h in data set P2. Hands in the Rukka suit were significantly warmer ($p < 0.05$) than in the Ursuit. Mean male final T_h was 4.1°C higher and mean female final T_h was 4.3°C higher with Rukka than with Ursuit. The overall drop in T_h was considerably smaller with the Rukka versus the Ursuit (P2-m: 2.6 and P2-f: 4.3°C less with Rukka). In the P4 data set, there were gender-based differences, particularly in final T_h (female T_h cooler) and ΔT_h (larger overall change in female T_h), therefore statistical analyses were separated in terms of sex. It was found that estimates of final T_h underestimated actual values by an average of 5.5°C. Predictions of ΔT_h overestimated the total fall by about 40%. In the P1 data set, however, no gender-based differences between actual or estimated T_h were demonstrated.

Subject Group	Mean Initial T_h			Mean Final T_h		
	Actual	Estimated	p	Actual	Estimated	p
P1-6m	29.7 ± 1.1	32.7 ± 0.0	0.004	12.2 ± 0.5	8.4 ± 0.1	0.000
P1-6f	28.3 ± 1.7	32.7 ± 0.0	0.004	13.2 ± 2.1	8.5 ± 0.2	0.008
P1-5	29.5 ± 3.6	32.7 ± 0.0	0.169	14.4 ± 6.3	9.0 ± 0.3	0.181
P1-4	27.1 ± 2.9	32.7 ± 0.0	0.030	11.3 ± 0.9	9.8 ± 0.5	0.038
P2-m	31.8 ± 2.5	32.7 ± 0.0	0.447	16.8 ± 3.3	8.8 ± 0.4	0.004
P2-f	31.6 ± 1.6	32.7 ± 0.0	0.215	18.1 ± 2.5	8.9 ± 0.8	0.000
P4-m	28.8 ± 1.7	32.7 ± 0.0	0.056	16.0 ± 1.8	9.5 ± 0.7	0.000
P4-f	30.6 ± 0.4	32.7 ± 0.0	0.089	12.8 ± 0.6	8.8 ± 0.2	0.014

Subject Group	Mean ΔT_h		
	Actual	Estimated	p
P1-6m	-17.5 ± 1.3	-24.1 ± 0.5	0.000
P1-6f	-15.1 ± 2.1	-24.2 ± 0.2	0.001
P1-5	-15.1 ± 4.1	-23.7 ± 0.3	0.024
P1-4	-15.8 ± 3.0	-22.9 ± 0.3	0.019
P2-m	-15.0 ± 3.1	-23.9 ± 0.4	0.003
P2-f	-13.5 ± 2.5	-23.8 ± 0.8	0.004
P4-m	-12.8 ± 1.0	-23.2 ± 0.7	0.000
P4-f	-17.9 ± 1.1	-23.9 ± 0.2	0.015

TABLE 4. Comparison of actual vs Model estimated hand temperature (°C). Group P4 separated by sex for T_h (m = male, f = female). Values given are ± 1 standard deviation, p = two-way unpaired t-test probability.

D. Foot Temperature (T_f)

1. Similar to T_h , T_f followed a simple second order decline profile upon CWI according to Model predictions. Also, the T_f characteristic curve shape was remarkable consistent during all simulation runs regardless of the Model inputs. Two notable exceptions were one of the P2 females and one of the P2 males who displayed an oscillatory increase in T_f after the initial decline. One might suspect that the feet of these subjects were not "relaxed" as modeled. Initial T_f was typically 35.8°C for P1 and P2. Foot temperatures and results of statistical comparisons are found in Table 5.

Estimated initial and final T_f were significantly greater than actual values for most of the data sets. Unlike the hands, predicted and actual P1 and P2 ΔT_f were not statistically different (except for P2 females). The fact that subjects' feet were not likely to be removed from the water until the run ended supports the assumptions listed above that validity of Model predictions relies on maintaining the same conditions during the course of the immersion. Therefore, T_f estimates were fairly good, given the disparity in starting temperatures.

Subject Group	Mean Initial T_f			Mean Final T_f		
	Actual	Estimated	p	Actual	Estimated	p
P1-6m	29.5 ± 1.4	35.8 ± 0.0	0.001	16.1 ± 4.1	18.7 ± 0.2	0.216
P1-6f	28.6 ± 1.5	35.8 ± 0.0	0.001	14.5 ± 2.8	18.8 ± 0.4	0.026
P1-5	27.1 ± 3.2	35.8 ± 0.0	0.012	10.6 ± 3.3	19.5 ± 0.3	0.013
P1-4	26.6 ± 2.9	35.8 ± 0.0	0.008	9.8 ± 1.0	20.2 ± 0.3	0.000
P2-m	28.6 ± 1.9	35.8 ± 0.0	0.000	14.9 ± 3.8	18.6 ± 0.7	0.000
P2-f	30.9 ± 2.8	35.8 ± 0.0	0.018	16.4 ± 4.8	19.7 ± 0.9	0.201
P5	21.6 ± 1.3	35.5 ± 0.0	0.000	9.8 ± 1.2	16.1 ± 1.1	0.000

Subject Group	Mean ΔT_f		
	Actual	Estimated	p
P1-6m	-13.5 ± 3.9	-17.1 ± 0.2	0.116
P1-6f	-14.1 ± 4.1	-16.9 ± 0.4	0.191
P1-5	-16.5 ± 4.6	-16.3 ± 0.3	0.938
P1-4	-16.7 ± 2.1	-15.6 ± 0.3	0.360
P2-m	-13.7 ± 3.7	-17.2 ± 0.7	0.000
P2-f	-14.6 ± 4.6	-16.1 ± 0.9	0.509
P5	-11.8 ± 1.8	-19.4 ± 1.1	0.000

TABLE 5. Comparison of actual vs Model estimated foot temperature (°C). Values given are ± 1 standard deviation, p = two-way unpaired t-test probability.

Estimated initial and final T_f were significantly greater than actual values for most of the data sets. Unlike the hands, predicted and actual P1 and P2 ΔT_f were not statistically different (except for P2 females). The fact that subjects' feet were not likely to be removed from the water until the run ended supports the assumptions listed above that validity of Model predictions relies on maintaining the same conditions during the course of the immersion. Therefore, T_f estimates were fairly good, given the disparity in starting temperatures.

There were no gender-based differences between actual or estimated T_f for data set P1. Model estimates of final T_f and ΔT_f were significantly different between P2 males and females ($p=0.049$ and $p=0.046$, respectively).

Actual and estimated P5 T_f curves were quite similar, though Model temperature predictions of initial and final T_f as well as the ΔT_f were significantly overestimated. The main deficiency with Model estimates of T_f was that upon immersion, predicted T_f fell by about 6°C - a value two to three times larger than actual data. It would appear that the subjects' boots had considerably more insulation than the 62/P ensemble. From the fact that the subject data declined with respect to time in the predicted fashion, one could assume that their feet were relatively inactive during the immersion period.

E. Thigh Temperature (T_t)

Model predictions indicated that T_t dropped exponentially to a plateau after CWI. Initial T_t was 33.6°C for P2 and P4, 33.4°C for P5. Thigh temperatures and results of statistical comparisons are found in Table 6.

In general, the actual subject T_t curves were similar to those predicted. While the Model overestimated both initial and final T_t , the estimated and actual ΔT_t were quite similar, indicating a reasonable fit for this body segment. No gender-based statistical differences between male and female T_t were demonstrated.

Predicted T_t curves were similar in form to T_{abd} and were analyzed similarly. While the actual P2 data did exhibit an exponential decline in T_t , the Model predicted that T_t would fall about twice as fast as it actually did (time for 80% drop in T_t (P2-m: 51.2 (Model) vs 98.0 min (males); P2-f: 49.6 (Model) vs 91.2 min (females)) (see Fig 3.). For group P4, the mean estimated T_t fall time was similar to the actual (70.0 ± 10.6 (Ts) vs 70.0 ± 13.2 min (Tm), $p=1.0$), as was the decline in temperature (-5.2 ± 1.6 (Ts) vs $-5.0 \pm 1.2^\circ\text{C}$ (Tm), $p=0.843$). For data set P5, the Model predicted that T_t would fall slightly faster than it actually did (time for 80% drop in T_t : 39.0 ± 5.7 (Ts) vs 29.3 ± 5.5 min (Tm), $p=0.108$), though estimates of the magnitude of the fall were close to the actual (6.8 ± 1.4 (Ts) vs $5.5 \pm 1.8^\circ\text{C}$ (Tm), $p=0.265$).

Subject	Mean Initial T_t			Mean Final T_t		
Group	Actual	Estimated	p	Actual	Estimated	p
P2-m	31.0 \pm 1.8	33.6 \pm 0.0	0.030	22.6 \pm 2.7	27.4 \pm 1.6	0.009
P2-f	29.0 \pm 1.4	33.6 \pm 0.0	0.002	20.3 \pm 0.8	26.6 \pm 1.2	0.000
P4	31.2 \pm 1.1	33.6 \pm 0.0	0.008	24.6 \pm 1.7	27.5 \pm 1.5	0.022
P5	32.2 \pm 0.9	33.4 \pm 0.0	0.019	23.0 \pm 2.6	25.5 \pm 2.6	0.064

Subject	Mean ΔT_t		
Group	Actual	Estimated	p
P2-m	-8.4 \pm 1.4	-6.3 \pm 1.6	0.051
P2-f	-8.7 \pm 1.5	-7.1 \pm 1.2	0.094
P4	-6.7 \pm 1.1	-6.2 \pm 1.5	0.587
P5	-9.3 \pm 2.8	-7.9 \pm 1.1	0.303

TABLE 6. Comparison of actual vs Model estimated thigh temperature ($^{\circ}\text{C}$). Values given are ± 1 standard deviation, p = two-way unpaired t-test probability.

F. Calf Temperature (T_{cf})

Model predictions indicated that T_{cf} gradually fell as a second order polynomial after CWI. Initial T_t was 33.0 $^{\circ}\text{C}$ for P2 and P4 and slightly cooler for P5. Calf temperatures and results of statistical comparisons are found in Table 7.

The overall shapes of both estimated and actual T_{cf} curves were in agreement for all groups. Even so, predictions of the initial and final temperatures were statistically different from actual T_{cf} except for data set P4. The estimated P2 ΔT_{cf} was significantly different from actual male ΔT_{cf} but not female, possibly due to the higher standard deviation in the female data. However, comparing the actual male and female data directly indicated no significant gender-based differences. Predicted P4 ΔT_{cf} were almost identical to actual values.

While the shapes of the actual and predicted P5 T_{cf} curves were in agreement, the Model overestimated the initial and underestimated the final T_{cf} to such an extent that ΔT_{cf} were as large as 5 $^{\circ}\text{C}$ (e.g. subject 1). However, the sample size was too small to generalize about the ability of the Model to predict T_{cf} under other conditions wearing Gore-Tex ensembles.

Subject Group	Mean Initial T_{cf}			Mean Final T_{cf}		
	Actual	Estimated	p	Actual	Estimated	p
P2-m	30.6 ± 1.9	33.0 ± 0.0	0.047	19.3 ± 2.4	22.1 ± 1.0	0.000
P2-f	29.5 ± 2.8	33.0 ± 0.0	0.011	17.5 ± 3.0	22.2 ± 0.8	0.019
P4	31.7 ± 1.1	33.0 ± 0.0	0.056	21.4 ± 1.8	22.7 ± 1.1	0.234
P5	31.3 ± 1.1	32.8 ± 0.0	0.018	20.8 ± 1.1	19.1 ± 0.8	0.012

Subject Group	Mean ΔT_{cf}		
	Actual	Estimated	p
P2-m	-11.3 ± 1.7	-10.8 ± 1.0	0.000
P2-f	-12.0 ± 2.1	-10.7 ± 0.8	0.245
P4	-10.3 ± 1.2	-10.3 ± 1.1	0.979
P5	-10.6 ± 1.4	-13.7 ± 0.8	0.001

TABLE 7. Comparison of actual vs Model estimated calf temperature ($^{\circ}\text{C}$). Values given are \pm 1 standard deviation, p = two-way unpaired t-test probability.

G. Arm Temperature (T_{am})

The Model predicted an exponential decline followed by a second order rise to a plateau during CWI. The Model consistently predicted a starting T_{am} of 32.8°C . Arm temperatures and results of statistical comparisons are found in Table 8.

Predicted P2 and P3 T_{am} curves were totally different from the actual temperatures with respect to time during CWI. Human T_{am} curves varied from linear to second order polynomials. Even though estimates were dissimilar to the actual curves with respect to a given point in time, predictions of ΔT_{am} , initial and final T_{am} were not statistically different from actual T_{am} except for P3 males.

It appears that Model estimates of P2 female T_{am} responses were somewhat better than the males, though there were no significant differences between male and female data, either actual or estimated. Since ΔT_{am} estimates were based on initial temperatures, P3 male and female data were analyzed separately. Estimates of male final and ΔT_{am} did not predict actual values well and female predictions were only marginally correct. Final T_{am} estimates were over 7°C higher than actual and, due to the predicted increase in T_{am} not seen in the actual data, ΔT_{am} estimates were one fourth the true size. It would appear that these non-significant differences were a result of very small means and relatively large standard deviations.

Subject Group	Mean Initial T_{am}			Mean Final T_{am}		
	Actual	Estimated	p	Actual	Estimated	p
P2-m	33.6 \pm 1.3	32.8 \pm 0.0	0.242	25.8 \pm 2.3	27.0 \pm 1.3	0.327
P2-f	32.5 \pm 0.9	32.8 \pm 0.0	0.509	24.7 \pm 5.2	26.4 \pm 0.9	0.516
P4-m	30.3 \pm 0.5	32.8 \pm 0.0	0.012	22.9 \pm 1.8	30.5 \pm 0.9	0.003
P4-f	33.0 \pm 0.3	32.8 \pm 0.0	0.427	23.2 \pm 2.6	30.8 \pm 1.0	0.059

Subject Group	Mean ΔT_{am}		
	Actual	Estimated	p
P2-m	-7.8 \pm 2.3	-5.8 \pm 1.3	0.127
P2-f	-7.7 \pm 5.3	-6.3 \pm 0.9	0.590
P4-m	-7.4 \pm 1.4	-5.7 \pm 1.2	0.026
P4-f	-9.8 \pm 2.8	-5.5 \pm 1.4	0.146

TABLE 8. Comparison of actual vs Model estimated arm temperature ($^{\circ}\text{C}$). Group P4 separated by sex for T_{am} (m = male, f = female). Values given are ± 1 standard deviation, p = two-way unpaired t-test probability.

H. Chest Temperature (T_c)

Model predictions of male T_c during CWI were somewhat different from female estimates. In both cases the initial exponential decline was followed by a rise. For females, that rise was followed by a slightly rising plateau. Male T_c curves, however, exhibited an overshoot followed by a slightly falling plateau. The Model predicted a starting T_c of 33.8 $^{\circ}\text{C}$. Chest temperatures and results of statistical comparisons are found in Table 9.

None of the actual P2 data curves had an exponential decline upon immersion. In four of five cases, however, the female T_c curves dropped to a minimum then increased. Two of the male T_c curves contained a dip following immersion followed by a rise to a relatively constant level. The other three curves simply continued to fall. Even though the Model underestimated P2 starting and final T_c and T_c changed with respect to time in a somewhat different fashion from that predicted, actual ΔT_c was not significantly different from the estimated values.

There were subject differences with respect to suit type with male T_c data. The males wearing the Rukka suit showed significantly smaller changes ΔT_c (-1.7 \pm 0.8 (Rukka) vs -4.0 \pm 0.4 $^{\circ}\text{C}$ (Ursuit), $p=0.036$) as well as final T_c (32.8 \pm 0.7 (Rukka) vs 31.0 \pm 0.4 $^{\circ}\text{C}$ (Ursuit), $p=0.05$). Model estimates and actual T_c comparisons, however, were not significantly different when tested separately with respect to suit worn. Again, there were no significant differences between male and female actual or estimated data regardless of suit worn.

Unlike P2, actual P4 T_c declined exponentially upon immersion. The slopes of this initial T_c decline were marginally similar to those predicted (-0.08 \pm 0.08 (Ts) vs -0.12 \pm 0.05 $^{\circ}\text{C}/\text{min}$ (Tm), $p=0.094$). However, the fall in T_c took about twice as long to reach a minimum than predicted (56.0 \pm 20.1 (Ts) vs 26.0 \pm 2.2 min (Tm), $p=0.03$). Female T_c , while not displaying the predicted dip in T_c , did drop to a minimum and then slowly increased. The male

data did display a noticeable dip in T_c followed by a rise to a plateau.

Statistical analyses of the temperature parameters indicated that Model estimates provided a good prediction of actual T_c data. Under the conditions of P3, the good agreement between the predicted values for the chest when compared to actual data taken from the shoulder blades, supports the approach taken by Wissler to model the upper torso as a cylinder with its internal temperatures radially distributed throughout its volume.

Subject Group	Mean Initial T_c			Mean Final T_c		
	Actual	Estimated	p	Actual	Estimated	p
P2-m	34.7 ± 0.7	33.8 ± 0.0	0.038	32.1 ± 1.1	30.4 ± 0.9	0.035
P2-f	35.0 ± 1.2	33.8 ± 0.0	0.085	32.8 ± 1.8	30.3 ± 0.6	0.031
P3	33.8 ± 0.6	33.8 ± 0.0	0.885	30.2 ± 2.1	30.6 ± 0.8	0.670

Subject Group	Mean ΔT_c		
	Actual	Estimated	p
P2-m	-2.6 ± 1.4	-3.4 ± 0.9	0.341
P2-f	-2.2 ± 1.9	-3.5 ± 0.6	0.202
P4	-3.7 ± 1.5	-3.2 ± 0.8	0.533

TABLE 9. Comparison of actual vs Model estimated chest temperature ($^{\circ}\text{C}$). Values given are ± 1 standard deviation, p = two-way unpaired t-test probability. Shoulder data was used in P4 since T_c was unavailable.

I. Heart Rate Changes During CWI

For all Model simulations, estimates of heart rate (HR) were well within the proposed limit of 80% of maximum HR calculated based upon age⁸. Calculated limits and Model predictions of maximum HR are listed in Table 10.

Study No.	Subj No.	Age (yr)	Calculated Max HR	Estimated Max HR
1	1	22	158.4	75.5
1	2	19	160.8	74.6
1	3	21	159.2	74.6
1	4	25	156.0	75.8
1	5	20	160.0	75.2
1	6	18	161.6	74.6
1	7	19	160.8	74.4
1	8	30	152.0	75.1
1	9	21	159.2	76.7
1	10	26	155.2	75.0
1	11	22	158.4	75.0
1	12	24	156.8	74.2
1	13	22	158.4	76.4
1	14	26	155.2	76.9
1	15	18	161.6	75.6
1	16	22	158.4	75.2
1	17	19	160.8	74.9
1	18	22	158.4	75.8
1	19	19	160.8	72.9
1	20	20	160.0	75.6
1	21	23	157.6	75.3
2	8	48	137.6	73.4
2	9	40	144.0	73.6
2	10	28	153.6	75.6
2	11	36	147.2	78.5
2	12	39	144.8	78.0
2	13	31	151.2	73.5
2	14	24	156.8	73.6
2	15	20	160.0	73.5
2	16	23	157.6	78.2
2	17	32	150.4	75.5
4	1	50	136.0	75.8
4	2	15	164.0	73.9
4	3	40	144.0	76.3
4	4	41	143.2	78.6
4	5	29	152.8	73.0
5	1	24	156.8	88.8
5	2	25	156.0	90.9
5	3	24	156.8	90.0
5	4	25	156.0	91.8
5	5	27	154.4	91.7
5	6	25	156.0	93.7

TABLE 10. Comparison of calculated 80% of maximum heart rate (HR; beats/minute) based on actual subject age ($80\% \text{ HR}_{\text{max}} = 0.80 * (220 - \text{age [yrs]})$) and the maximum HR as predicted by the Model. $80\% \text{ HR}_{\text{max}}$ is the allowable USN physiologic limit.

V. DISCUSSION

1. The inherent variability in human physiologic responses to stress underscore the pitfalls in human mathematical modeling. In this analysis we have assumed that the Model itself has enough flexibility to account for reasonable amounts of individual differences. It certainly is incapable of anticipating all possible responses. As such, the Model is best used as a guide in determining trends of human responses during hazardous conditions. Furthermore, determining whether or not a model is "valid" is difficult in that the concept of what constitutes validity itself is a difficult to define. The best one could hope for is that mathematical predictions follow overall physiologic trends reasonably (e.g. relative changes over time are similar to actual data) and can identify those conditions which would be too hazardous for safe human testing.

2. In general, there were considerable differences in human thermal responses of the various body segments between individuals within the same study. For example, Model starting temperatures were very consistent, while human initial temperatures varied by considerably wider margins. In particular, females tended to have somewhat warmer starting segment temperatures than males. Initial Model and human skin and T_{re} were often different, sometimes over 1°C higher or lower. In some cases, but clearly not all, these starting differences led to Model predictions which only varied from the actual data by a constant offset.

Another possible source of error was the assumption that the modeled subject was relaxed and completely immersed except for the head. It was possible that deficiencies in Model predictions could have been caused by periods in which part of the subjects' bodies could have been out of the water, such as arms folded across the chest, or if legs and feet were moving.

Even though environmental and physical variables were matched as closely as possible, in the final analysis, any thermal predictions obtained were only as good as the assumed garment CLO values used by the Model. It was assumed that garments used in P1, P2 and P4 were similar to the CWU-60/P. In fact, the Finnish reports indicated that the thermal properties of different suits varied, particularly the insulating capabilities of the suit extremities. Deficiencies in the modeling of P5 data with the 62/P ensemble were listed in the Results section.

3. Two significant limitations were uncovered during this analysis. The first lies in the fact that the human included in the Model is male. As such, modelling female thermal responses in many cases was inadequate. For example, the Model computes T_{re} as a weighted combination of arterial, venous and abdominal temperatures¹⁰. In order to provide better estimates of female T_{re} , these weighting factors would have to be adjusted. Second, in order to compare predicted initial and final temperatures based upon a given set of human data, it is essential to be able to specify starting segment temperatures. In its current form, the algorithm for calculating initial segment temperatures incorrectly estimated these temperatures for most of the body segments (except for the arm and chest). Therefore, the most "valid" way to interpret Model thermal simulations is to focus on the relative change in temperature estimates.

4. Rectal temperature

Model estimates of initial T_{re} tended to be too low. Only in P4, P5 and P2 males were starting T_{re} predictions not statistically different from actual T_{re} . Final T_{re} estimates were acceptable using the 60/P CLO values for all groups tested except P1-4. Model predictions for P5 were too conservative. Given the fact that actual starting temperatures throughout this analysis have often been quite different from Model estimates, the key parameter in judging the predictive capability of the Model is the ΔT_{re} caused by CWI. Excluding P5 data, Model predictions of ΔT_{re} were not statistically different from actual data for 86% of the tests performed. Furthermore, the rate of change in the drop in T_{re} was also not statistically different from actual data, except for P5. It is interesting to note that only 16 subjects (36% of the sample)

exhibited the initial rise in T_{re} caused by increased peripheral vasoconstriction. This may have been due to the temperature sampling rate and sensitivity of measuring devices used in the Finnish studies. Model predictions of this rise typically estimated a maximum duration of 30 minutes with an increase of 0.05 to 0.11°C. It may not have been possible to distinguish temperature changes of this magnitude during the human trials. Interestingly, more subjects in P5 (T_{re} sampled every 5 minutes) exhibited this response (4 of 6) than in the other tests and the duration of these peaks lasted longer than the others. It is possible that the actual Gore-Tex ensemble worn by P5 subjects provided more insulation than predicted using the 62/P CLO values.

5. Chest temperature

T_c was measured only in P2 and P4. Initial and final temperature predictions were valid for all but P2 females. Female subject T_c tended to be warmer than predicted. However, for all groups, ΔT_c predictions were valid. However, the actual T_c curves were not accurately predicted with respect to time. Therefore, based on a small sample of fifteen subjects, Model predictions will be most useful in terms of overall response, as opposed to minute by minute estimates. The failure to predict the female responses more accurately is probably due to the fact that the Model subject is male and gender-based differences were demonstrated in the subject data.

6. Abdomen temperature

T_{abd} was recorded in P1, P4 and P5. The Model indicates that T_{abd} should fall exponentially to a plateau. Subjects in P4, 4 of 6 in P5 and 3 of 21 in P1 exhibited such a characteristic curve. Predictions of initial T_{abd} overestimated actual responses in P1, though estimates were valid for the other two groups. Final T_{abd} predictions were inconsistent. Model estimates of final T_{abd} for P1 subjects completing the full six hour CWI and P4 subjects were statistically valid. The Model overestimated T_{abd} for group P1-5 and underestimated it for P1-4 and P5. Most of the ΔT_{abd} predictions, except for P1-6f and P1-4, overestimated the extent of the drop in T_{abd} . While ΔT_{abd} estimates could have matched the actual data better, Model predictions for P4, P5, groups P1-6f, P1-5 and P1-4 were consistently too large. Use of these consistently conservative estimates would allow for a larger margin of safety when using the Model for design or evaluation purposes.

7. Arm temperature

T_{am} was measured only in P2 and P4. As in the chest predictions, the actual and estimated T_{am} curves were poorly matched. However, initial T_{am} and ΔT_{am} estimates were valid except for P4 males. Final T_{am} predictions were valid for P2 data. Gender-based differences between P4 males and females were demonstrated for this segment. Even though 80% of the ΔT_{am} predictions using this portion of our population sample were valid, more human data should be obtained before making any conclusions about T_{am} .

8. Hand temperature

T_h was measured in P1, P2 and P4. Estimated and actual curves were similar in appearance. Starting T_h estimates were too high for groups P1-6m, P1-6f and P1-4 and valid for the rest. However, Model estimates of final T_h (except for P1-5) and ΔT_h were greatly overestimated.

During this simulation, it was assumed that the entire body, except the head, remained immersed and inactive. It is probably reasonable to assume that the subjects did not leave their hands totally immersed at all times - they might have rested them on their chests, for example. They may have flexed their fingers periodically, which will increase overall T_h . This probably

would account for the differences observed. However, even though conservative estimates of temperature increase safety limits when using this Model, in this case these predictions were much too low. This is because current USN requirements and the "stop-the-run" conditions imposed during these human tests would have ended the simulation prematurely in a majority of the runs when T_h fell to or below 10°C .

9. Thigh temperature

T_t was recorded in P2, P4 and P5. Actual initial and final T_t were consistently lower than Model predictions. However, ΔT_t estimates were not statistically different for all data comparisons. The actual and predicted curve shapes were quite similar in these tests except for the female subjects. These subjects exhibited a wide range of T_t values after the first hour of immersion not predicted by the Model.

10. Calf temperature

T_{cf} was measured in P2, P4 and P5. Predicted and actual T_{cf} curves were in agreement over time. Initial temperature estimates were too high except for P4 subjects. Final temperature estimates were too great for P2, too low for P5 and agreed with P4 data. ΔT_{cf} estimates were valid for P2 females and P4 but were too high for P5 and too low for P2 males. There were no sex-based differences. It is possible that the 60/P CLO value estimates for the legs in the Bayley Immersion Suit (P4) were better matched than for the Rukka, Ursuit or Gore-Tex ensembles. This could account for the variability seen in the ΔT_{cf} results.

11. Foot temperature

T_f was successfully recorded in P1, P2 and P5. Actual T_f responses tended to be more linear than predicted by the Model. Initial T_f was always overestimated. Final T_f estimates were only valid for groups P1-6m and P2-f. However, ΔT_f estimates were valid for all of P1 and P2 females. ΔT_f was overestimated for P5 and P2 males. The problem with the latter data set was the occurrence of oscillatory patterns in the data set which may have indicated that some subjects did not keep their feet relaxed. As with the T_{re} predictions using P5 data, it is possible that the actual Gore-Tex ensemble worn by these subjects provided more foot insulation than predicted using the 62/P CLO values.

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Texas Human Thermal Model Sensitivity Analysis

I. MODEL ASSESSMENT

Approach

The primary purpose of this study was to investigate the performance of the Texas Human Thermal Model during simulated head-out CWI. To accomplish this, a sensitivity analysis was performed in which individual Model parameters were varied while keeping all others constant to determine their effect on estimated T_{re} and mean skin temperature (T_{sk}). These parameters included body segment CLO values and the physical and exercise characteristics of an individual and his environment. The garment modelled in this analysis was based on the current standard USN anti-exposure ensemble: the CWU-62/P. End points used during this analysis were based on the USN Operational Thermal Requirements for Cold Water Immersion¹²: maintain (1) T_{re} above 35°C and (2) T_{sk} above 15°C. Additional end points included the time required to reach (1) the metabolic "fatigue" limit (point at which shivering stopped and central temperature (T_{cn}) transiently rose) or (2) an estimated arterial temperature of 32.5°C.

II. METHODS

A. Standard conditions used are defined as follows:

1. Body segment CLO distribution was

Segment:	Chest	Abdomen	Head*	Arm	Hand	Leg	Foot
CLO:	0.80	0.80	4.16	0.10	0.10	0.60	0.50

* Default Model USAF helmet value.

2. The idealized standard man used in this analysis was 160 lb (72.7 kg) with a 10 mm mean skinfold thickness. He was positioned in a relaxed sitting posture during simulated head-out CWI. Basal metabolic rate was set at 100 watts. The exercise metabolic rate was 1 BTU/hr and this effort was distributed over the body as 20% arms, 50% legs, 15% abdomen and 15% chest. Clothing was initially dry with an impermeable covering and included a standard USAF helmet. Environmental conditions included 100% relative humidity, barometric pressure of 760 torr and a 2 mph (0.89 m/s) wind speed.

B. Body segment CLO values were tested as follows:

1. Individual body segment CLO values were varied while holding the others constant as follows. The chest, abdomen and head segments were modelled during both 28 and 40°F CWI while the other segments were modelled only at 40°F water.

2. The chest and abdomen segments were varied together from 0.01 to 2.0 since both segments had the same CLO value in the 62/P.

3. The right and left leg (thigh and calf) CLOs were varied together from 0.01 to 1.8 while the foot segment was held at the standard 0.5 CLO.

4. The right and left foot CLOs were varied together while the leg segments were held at the standard 0.6 CLO. The segment CLOs were varied from 0.01 to 1.8.

5. Four different variations were tested for the arm and hand segments. In each case, right and left arms were set equal. In Case 1, arm CLO was set equal to hand CLO and tested from 0.01 to 2.0. In Case 2, the arm CLO was varied while holding the hand at the standard 0.1 CLO (arm tested from 0.05 to 2.0). For Case 3, the hand CLO was varied while holding the arm at the standard 0.1 CLO (hand tested from 0.01 to 0.15). A fourth case was run in which the hand CLO was tested at each of the Case 3 values with each of arm CLO values as in Case 2.

6. To study the effect of head coverage, the Model was run for 6 hours without a helmet and compared to the standard CLO configuration.

C. Physical, exercise and environmental characteristics were varied while using the standard Model configuration as follows. In each case, water temperature was modelled at 40°F. Wind speed was varied from 0 to 74 mph. Body weight was tested at the 5th (140 lb), the 50th (171 lb), the 75th (184 lb) and the 95th (204 lb) percentiles. Mean skinfold thickness (MST) was varied from 3 to 15 mm. Basal metabolic rate (BMR) was varied from 50 to 200 watts. Exercise metabolic rate (EMR) was varied from 1 to 1000 BTU/hr. One can vary the relative contribution of four different body segments to the exercise performed by the Model subject ("Exercise metabolic distribution" (EMD)). The combinations tested in this analysis are shown in Table 11. Run D in Table 11 simulated upper body exercise. The Model allows for a variety of physical activities, including standing, sitting, treadmill walking, walking and stationary bike riding. The sole activity tested in this study was sitting, since none of the others were appropriate. Variations in EMD may indeed become a factor with other postures, but were not tested.

Run No.	Arm	Leg	Abdomen	Chest
STD	20%	50%	15%	15%
A	30%	40%	15%	15%
B	40%	30%	15%	15%
C	50%	20%	15%	15%
D	30%	30%	15%	25%

TABLE 11. Relative contribution of body segments to exercise metabolic distributions tested. STD was the standard distribution.

III. RESULTS

A. Segment CLO Assessment

1. With the standard CLO configuration in 40°F water, the Model reached a fatigue limit after 265 minutes. In 28°F water, fatigue limit was reached after 165 minutes.

2. Chest and abdomen segments

a. If the chest and abdomen CLO were set to a level greater than 1.6, the 6 hour CWI was completed without fatigue. Therefore, a 360 minute 40°F immersion was possible with chest and abdomen segment CLOs = 2.13 * standard chest and abdomen CLO. At 28°F, CLO values up to 2.0 were insufficient to continue immersion beyond 240 minutes. Table 12 details the time predicted for T_{re} and T_{sk} to reach critical levels, for T_{cn} to fall to 35°C and when metabolic fatigue was predicted for the CLO values tested during 28°F and 40°F CWI. Estimates of T_{re} and T_{sk} (°C) at the end of the CWI are also given.

b. Figure 10 shows a plot of CLO vs time to fatigue at 40°F and indicates two breakpoints at which point the slope changes. The three distinct regions are described below.

Range (CLO)		Slope (min/1.0 CLO)	time to fatigue (min) for	
lower limit	upper limit		lower CLO range limit	upper CLO range limit
0.8	1.6	-112.5	265	355
0.1	0.7	-216.7	110	250
0.01	0.1	-300.0	80	110

c. Nonlinear regressions of chest and abdomen CLO versus time at fatigue for 28 and 40°F water are given by

$$40^{\circ}\text{F: Time to fatigue} = (77.096 + 420.959 x) / (1 + 0.691 x) \quad r^2 = 0.99$$

$$28^{\circ}\text{F: Time to fatigue} = (51.886 + 247.009 x) / (1 + 0.656 x) \quad r^2 = 0.99$$

where x = chest and abdomen CLO (other segment CLOs held at standard values).

d. Figures 11-13 contain plots of T_{re} , T_{cn} and T_{sk} while varying chest and abdomen CLOs from 1.6 to 0.01. Note the gradual parabolic decline in T_{cn} , the initial rise followed by a parabolic decline in T_{re} and the abrupt drop in T_{sk} after immersion followed by a relatively slight linear decline over time.

40°F Water							28°F Water					
CLO	T _{re} (min)	T _{cn} (min)	T _{sk} (min)	Time to fatigue (min)	T _{re} at EOI (°C)	T _{sk} at EOI (°C)	T _{re} (min)	T _{cn} (min)	T _{sk} (min)	Time to fatigue (min)	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
2.0	nf	nf	nf	nf	35.6	22.7	*	165	*	240	35.2	19.1
1.8	nf	nf	nf	nf	35.5	22.5	*	155	*	225	35.2	19.5
1.6	*	345	*	355	35.4	22.1	*	145	*	215	35.2	19.4
1.4	*	315	*	335	35.4	22.0	*	140	*	205	35.2	19.1
1.2	*	275	*	315	35.3	21.7	*	130	*	195	35.1	18.7
1.0	*	225	*	295	35.2	21.2	*	115	*	180	35.1	18.4
0.9	*	200	*	280	35.2	21.0	*	110	*	175	35.0	18.0
0.8	*	180	*	265	35.2	20.8	*	105	*	165	35.0	17.8
0.7	*	165	*	250	35.1	20.5	*	100	*	155	35.0	17.6
0.5	*	130	*	215	35.0	19.6	135	85	*	135	34.9	16.5
0.3	165	100	*	170	34.9	18.3	105	65	*	105	35.0	15.3
0.2	135	80	*	140	34.9	17.6	90	55	55	90	34.9	14.0
0.1	105	65	*	110	34.9	16.2	70	45	15	70	35.0	12.5
0.08	100	60	*	105	34.9	15.6	70	40	15	70	34.9	11.4
0.05	90	55	95	95	34.9	15.0	*	40	10	60	35.0	11.2
0.03	85	50	70	90	34.9	14.4	60	35	10	60	34.9	10.2
0.01	75	45	25	80	34.8	13.4	*	30	5	50	35.1	9.5

TABLE 12. Time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 28°F and 40°F CWI (EOI) for various chest and abdomen CLO values. nf: no fatigue after 6 hours; *: The Model predicted fatigue before reaching critical temperature. Standard CLO = 0.8.

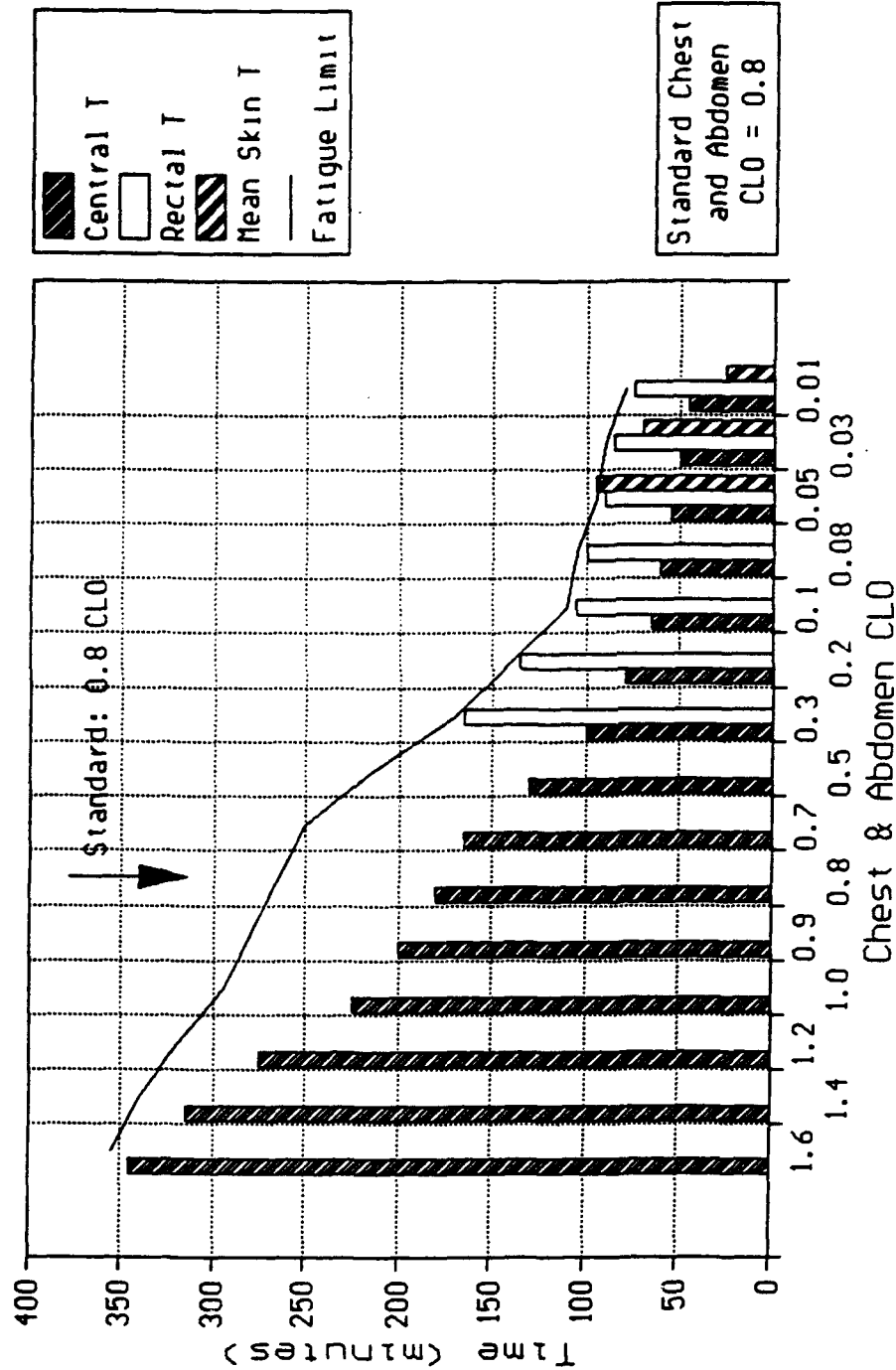
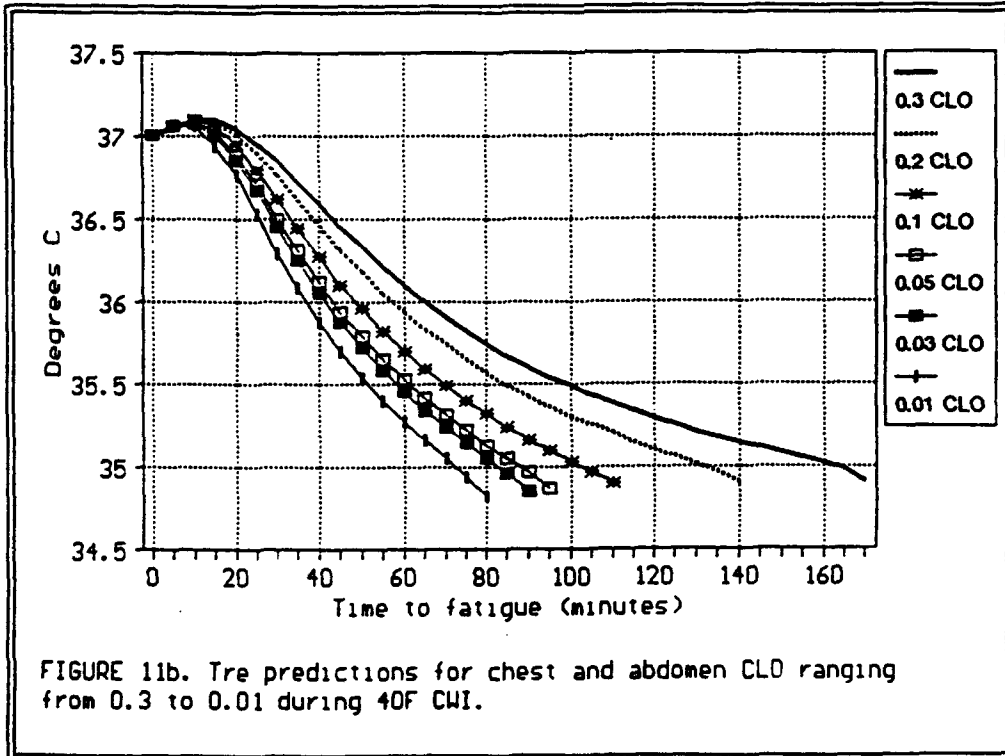
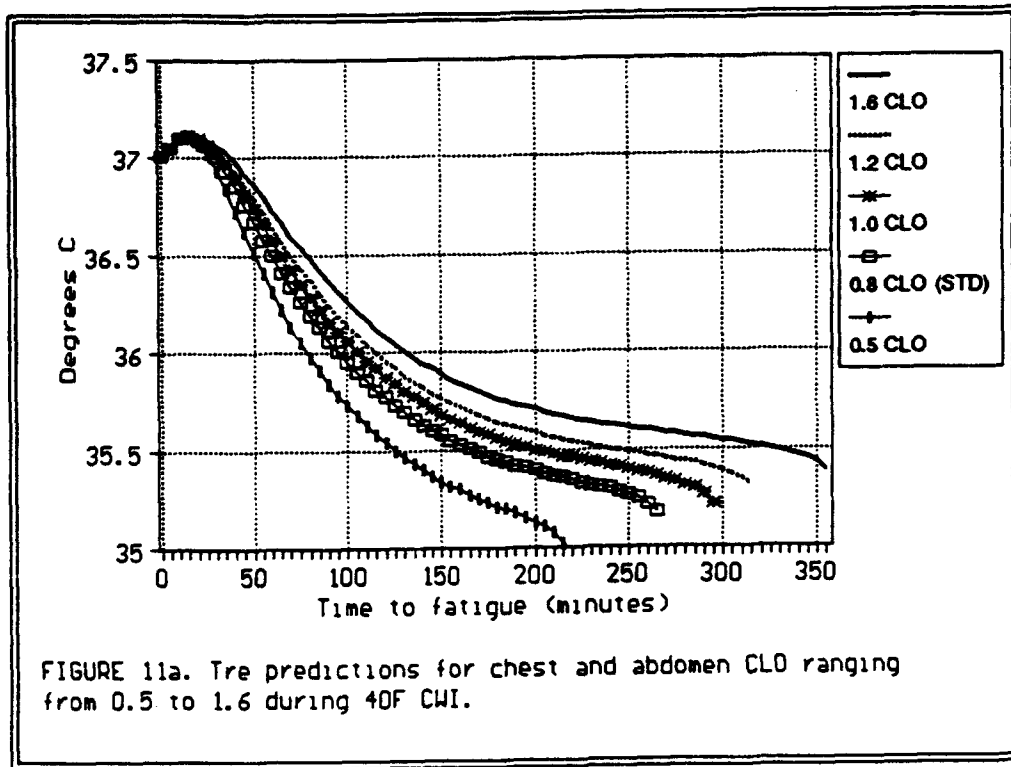
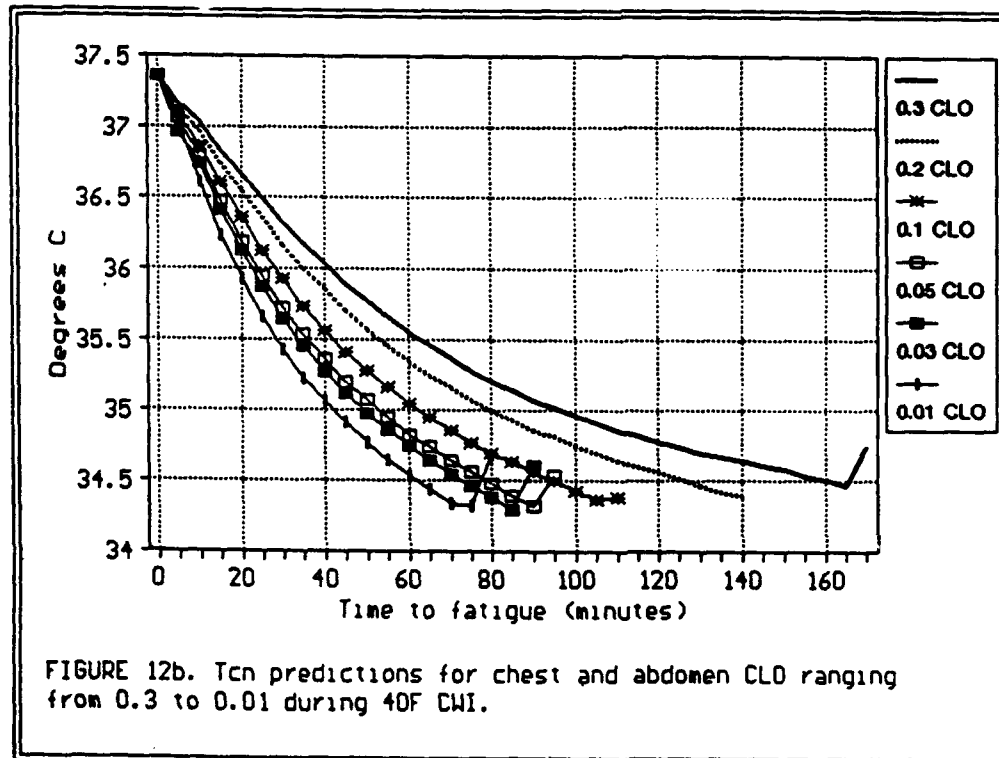
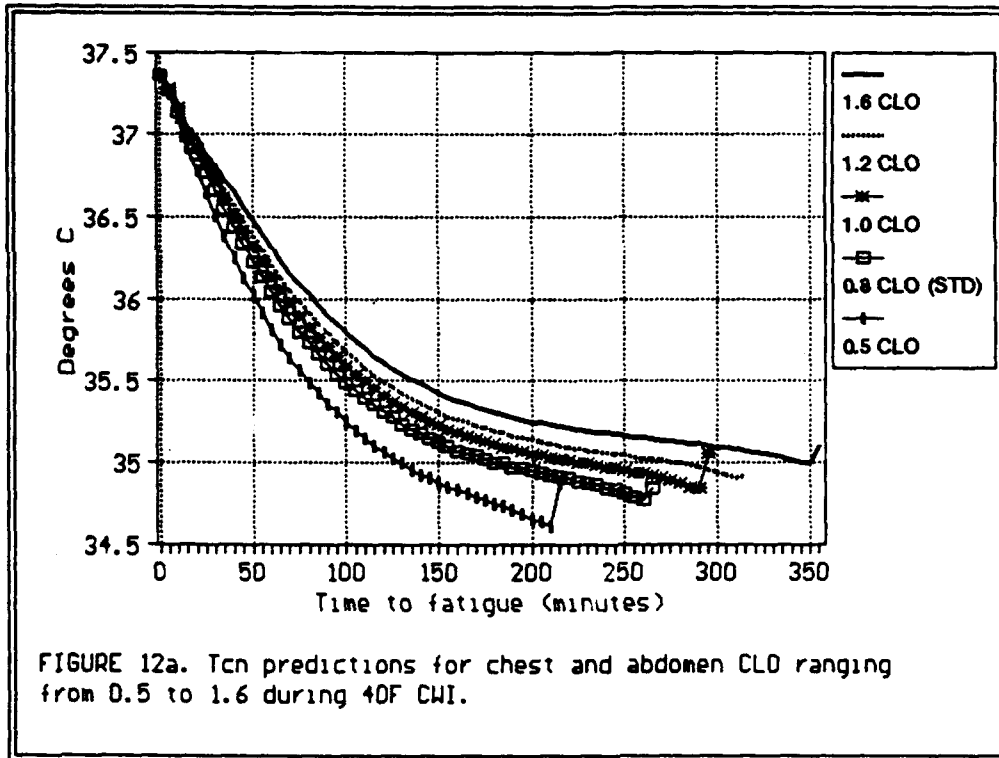
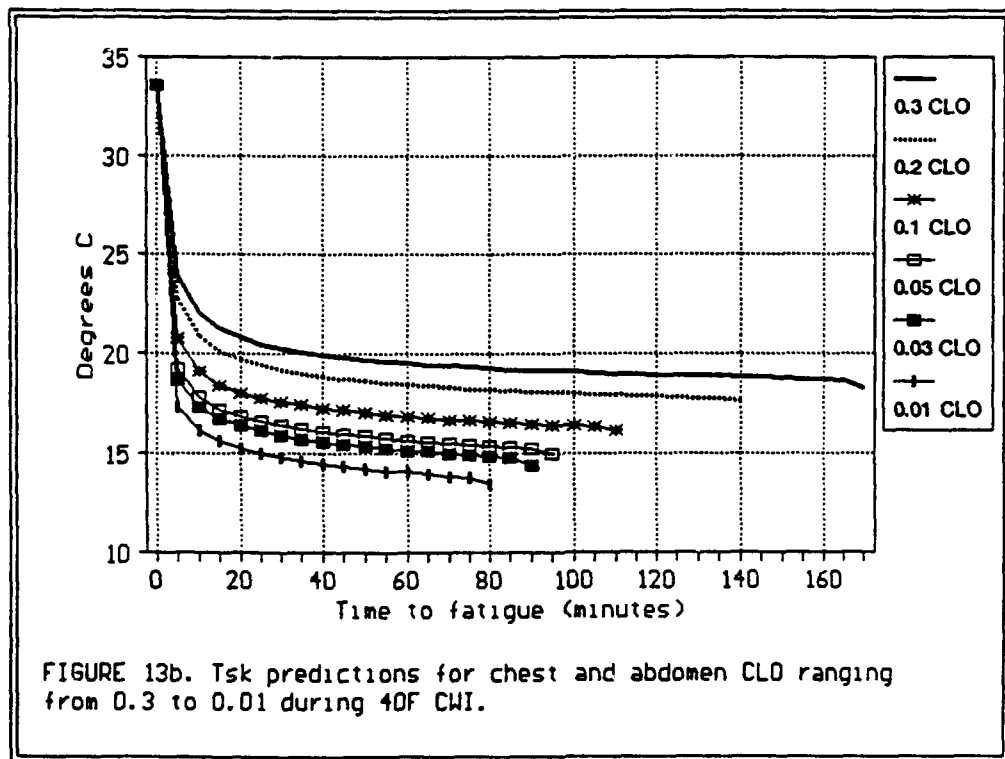
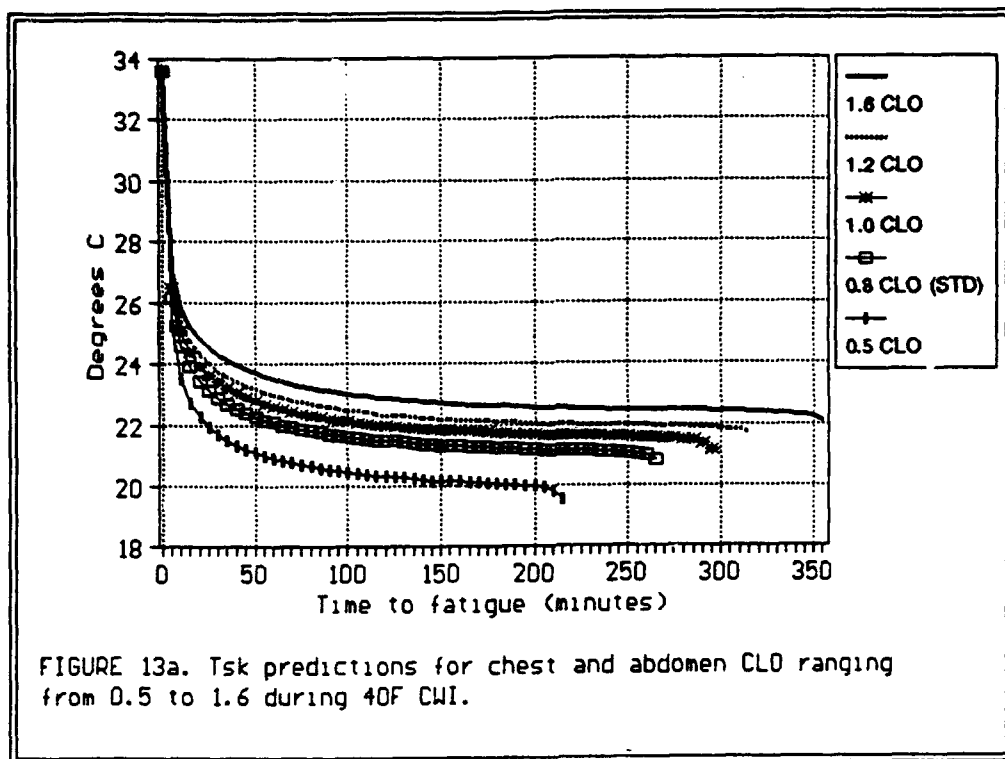


FIGURE 10. Time to critical Tre, Tsk and Tcn and metabolic fatigue limits for various chest & abdomen CLO values during 40F CWI.







3. Leg segments

a. If the leg CLO was ≥ 1.2 , 6 hour CWI was completed without fatigue at 40°F. Therefore, a 360 minute CWI was possible with leg segment CLO = 2.0 * standard leg CLO. Table 13 details the time predicted for T_{re} and T_{sk} to reach critical levels, for T_{cn} to fall to 35°C and when fatigue halted computations for the CLO values tested while immersed in 40°F water. Note that once T_{re} did reach critical (35°C), fatigue followed, though 5 to 10 minutes later than in the chest and abdomen runs.

b. Figure 14 shows a plot of CLO vs time to fatigue at 40°F, indicating two breakpoints at which the slope changes. The three distinct regions are described below:

Range (CLO)		Slope (min/1.0 CLO)	time to fatigue (min) for	
lower limit	upper limit		lower CLO range limit	upper CLO range limit
0.5	to 1.0	-191.7	245	340
0.1	to 0.5	-275.0	135	245
0.01	to 0.1	-350.0	100	135

c. Figures 15-17 contain plots of T_{re} , T_{cn} and T_{sk} while varying leg CLOs from 0.01 to 1.0. Note that the greatest change in temperatures occurred between 0.1 and 1.0 CLO. A nonlinear regression of leg CLO versus time at fatigue for 40°F water is given by

$$\text{Time to fatigue} = (101.419 + 404.224 x) / (1 + 0.490 x) \quad r^2 = 0.99$$

where x = leg CLO (other segment CLOs held at standard values).

CLO	T_{re} (min)	T_{cn} (min)	Time to fatigue (min)	T_{re} at EOI (°C)	T_{sk} at EOI (°C)
1.8	nf	nf	nf	35.7	23.2
1.6	nf	nf	nf	35.6	23.0
1.4	nf	nf	nf	35.6	22.7
1.2	nf	nf	nf	35.5	22.4
1.0	*	330	340	35.3	21.8
0.8	*	260	305	35.3	21.4
0.7	*	215	285	35.2	21.2
0.6	*	180	265	35.2	20.8
0.5	*	155	245	35.1	20.3
0.3	195	115	195	35.0	19.1
0.2	155	95	165	34.9	18.5
0.1	120	80	135	34.8	17.3
0.08	115	75	130	34.8	16.9
0.05	105	70	120	34.7	16.4
0.03	100	65	115	34.7	16.1
0.01	90	60	100	34.7	15.7

TABLE 13. Time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) for various leg CLO values (foot CLO = 0.5). nf: no fatigue after 6 hours; *: The Model predicted fatigue before reaching critical temperature. Standard leg CLO = 0.6.

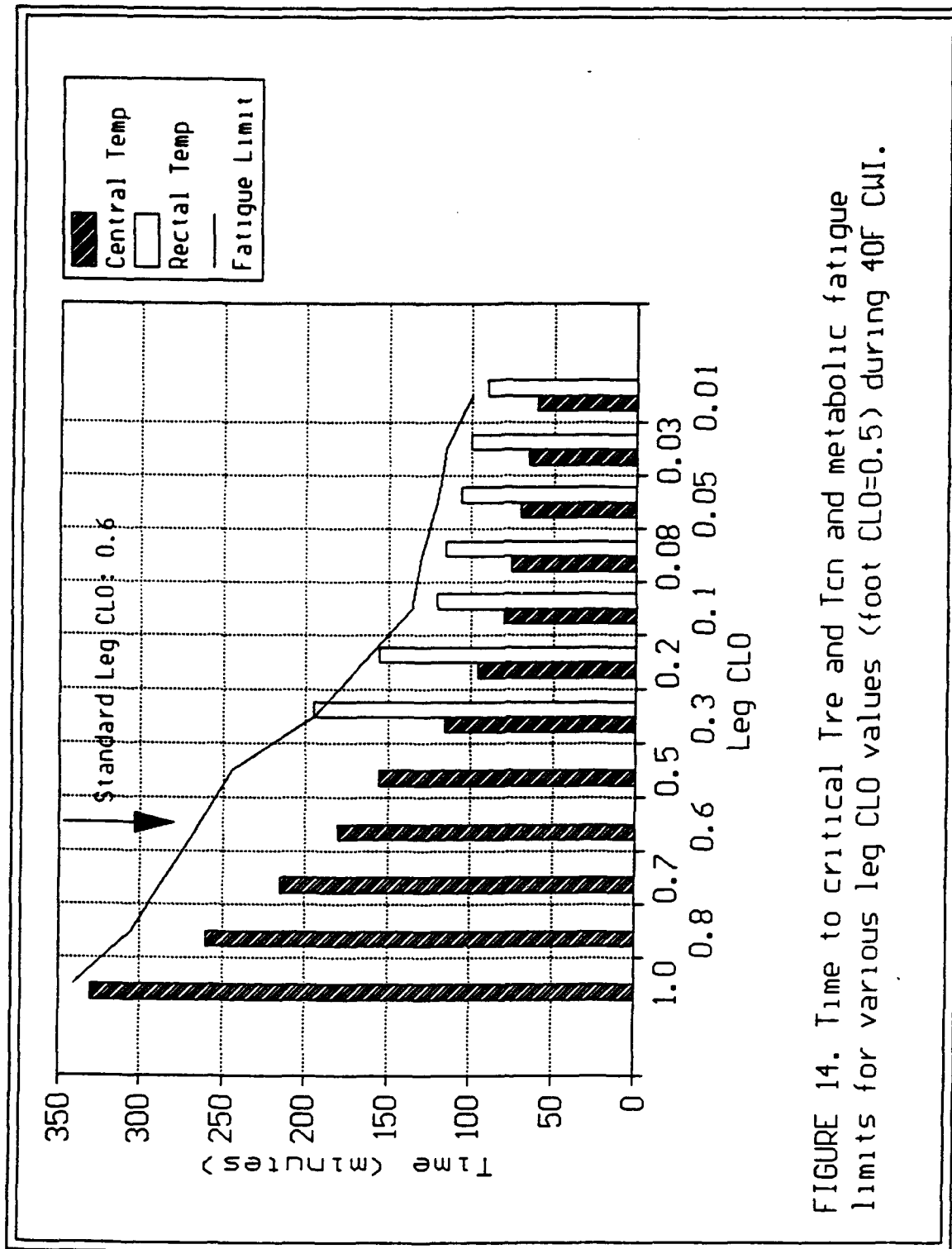


FIGURE 14. Time to critical Tre and Tcn and metabolic fatigue limits for various leg CLO values (foot CLO=0.5) during 40F CWI.

while immersed in 40°F water. Note that once T_{re} did reach critical (35°C), fatigue followed, though 5 to 10 minutes later than in the chest and abdomen runs.

CLO	T_{re}	T_{cn}	T_{sk}	Time to fatigue
1.8	nf	nf	nf	nf
1.6	nf	nf	nf	nf
1.4	nf	nf	nf	nf
1.2	nf	nf	nf	nf
1.0	*	330	*	340
0.8	*	260	*	305
0.7	*	215	*	285
0.6	*	180	*	265
0.5	*	155	*	245
0.3	195	115	*	195
0.2	155	95	*	165
0.1	120	80	*	135
0.08	115	75	*	130
0.05	105	70	*	120
0.03	100	65	*	115
0.01	90	60	*	100

TABLE 13. Time (minutes) to reach critical temperatures and fatigue during 40°F water immersion for various leg CLO values (foot CLO = 0.5). nf: no fatigue after 6 hours; *: Model fatigued before reaching critical temperature. 0.6 was the standard leg CLO value.

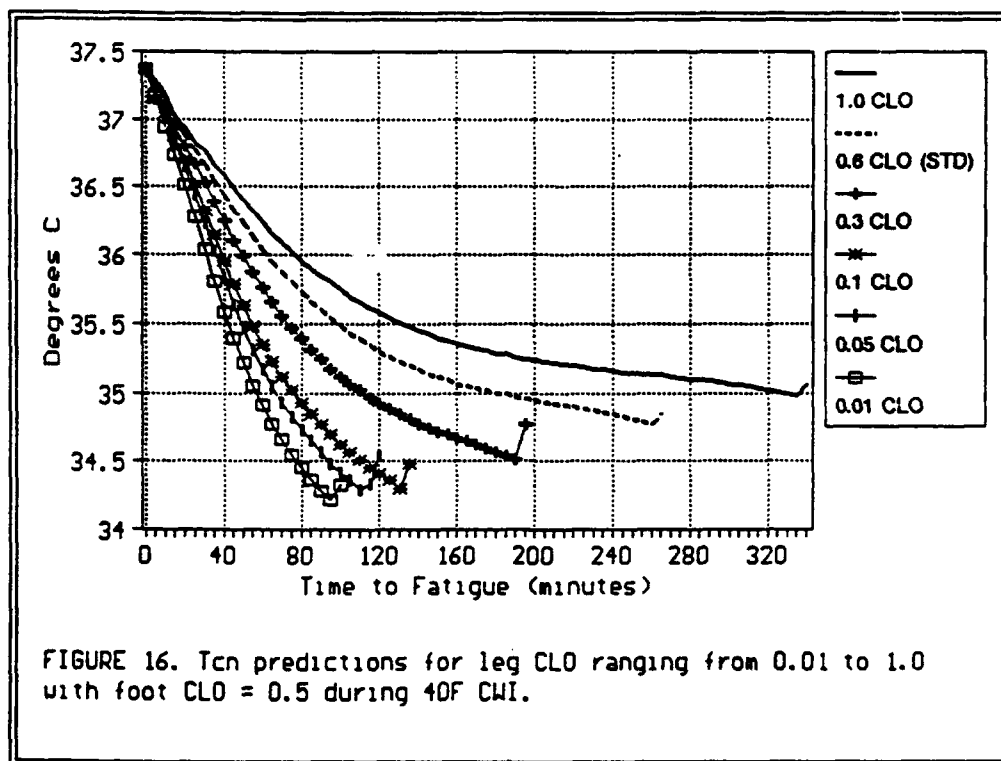
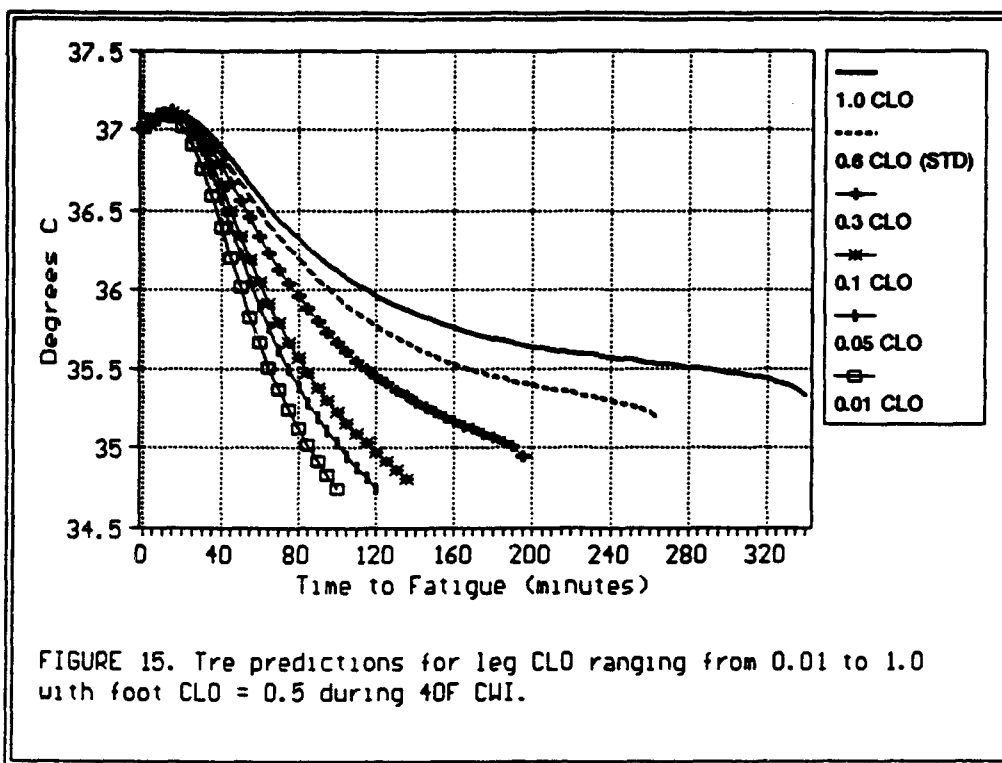
e. Figures 15-17 contain plots of T_{re} , T_{cn} and T_{sk} while varying leg CLOs from 0.01 to 1.0. Note that the greatest change in temperatures occurred between 0.1 and 1.0 CLO.

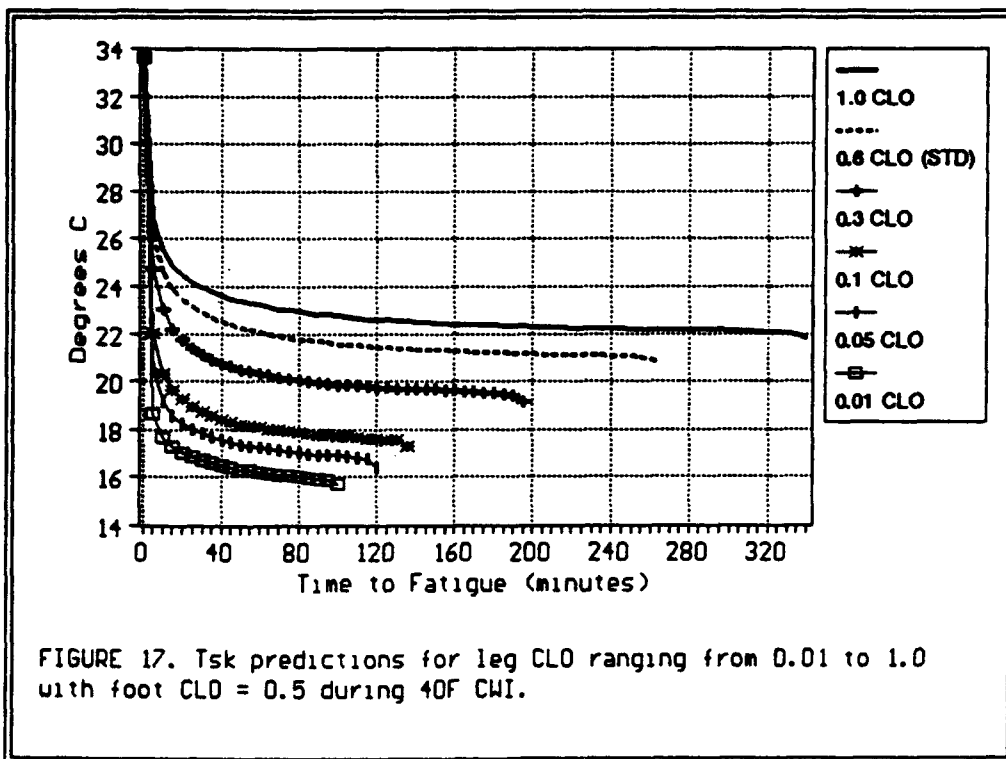
4. Foot segment

a. With all tested foot CLO values, 6 hour immersions were not completed prior to reaching fatigue (see Table 14). It was apparent that increasing foot insulation alone was not enough to prevent fatigue. However, in comparison to the standard configuration, increasing foot insulation greater than the standard (0.7 to 1.8 CLO) delayed fatigue by 10 to 30 minutes.

b. Unlike the chest, abdomen and leg segments, a plot of foot CLO vs time to fatigue at 40°F indicates a relatively linear variation (see Figure 18). However, when CLO dropped below 0.1, time to fatigue accelerated as compared to higher CLO values, though the absolute change was small given the already short survival times. These changes are described by:

Range (CLO)		Slope (min/1.0 CLO)	time to fatigue (min) for	
lower limit	upper limit		lower CLO range limit	upper CLO range limit
0.1	to 1.8	- 31.3	245	295
0.01	to 0.1	-150.0	235	245





4. Foot segment

a. With all tested foot CLO values, 6 hour CWI were not completed prior to reaching fatigue (see Table 14). It was apparent that increasing foot insulation alone was not enough to prevent fatigue. However, in comparison to the standard configuration, increasing foot insulation greater than the standard (0.7 to 1.8 CLO) delayed fatigue by 10 to 30 minutes.

b. Unlike the chest, abdomen and leg segments, a plot of foot CLO vs time to fatigue at 40°F indicates a relatively linear variation (see Figure 18). However, when CLO dropped below 0.1, time to fatigue accelerated as compared to higher CLO values, though the absolute change was small given the already short survival times. These changes are described by:

Range (CLO)		Slope (min/1.0 CLO)	time to fatigue (min) for	
lower limit	upper limit		lower CLO range limit	upper CLO range limit
0.1	to 1.8	- 31.3	245	295
0.01	to 0.1	-150.0	235	245

CLO	T _{re} (min)	T _{cn} (min)	Time to fatigue (min)	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
1.8	*	285	295	35.3	20.9
1.6	*	275	290	35.4	21.1
1.4	*	265	290	35.3	20.9
1.2	*	255	285	35.3	20.9
1.0	*	235	275	35.3	21.0
0.8	*	215	275	35.3	20.9
0.7	*	205	275	35.2	20.7
0.5	*	180	265	35.2	20.8
0.3	*	160	255	35.1	20.8
0.2	*	150	250	35.1	20.7
0.1	245	140	245	35.0	20.4
0.08	*	135	240	35.0	20.6
0.05	240	135	240	35.0	20.4
0.03	*	130	235	35.0	20.6
0.01	235	130	235	35.0	20.4

TABLE 14. Time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) for various foot CLO values (leg CLO = 0.6). *: The Model predicted fatigue before reaching critical temperature. Standard foot CLO = 0.5.

c. Figures 19-21 contain plots of T_{re}, T_{cn} and T_{sk} at foot CLOs from 0.01 to 1.0. Though there was less temperature variation when varying foot CLO as compared to the above segments, the greatest change in T_{cn} and T_{re} occurred between 0.1 and 1.0 CLO. Changing foot CLO had little effect on T_{sk}. A linear regression of foot CLO versus time to fatigue is described by

$$\text{Time to fatigue} = 33.88 x + 241.26$$

$$r^2 = 0.94$$

where x = leg CLO (other segment CLOs held at standard values).

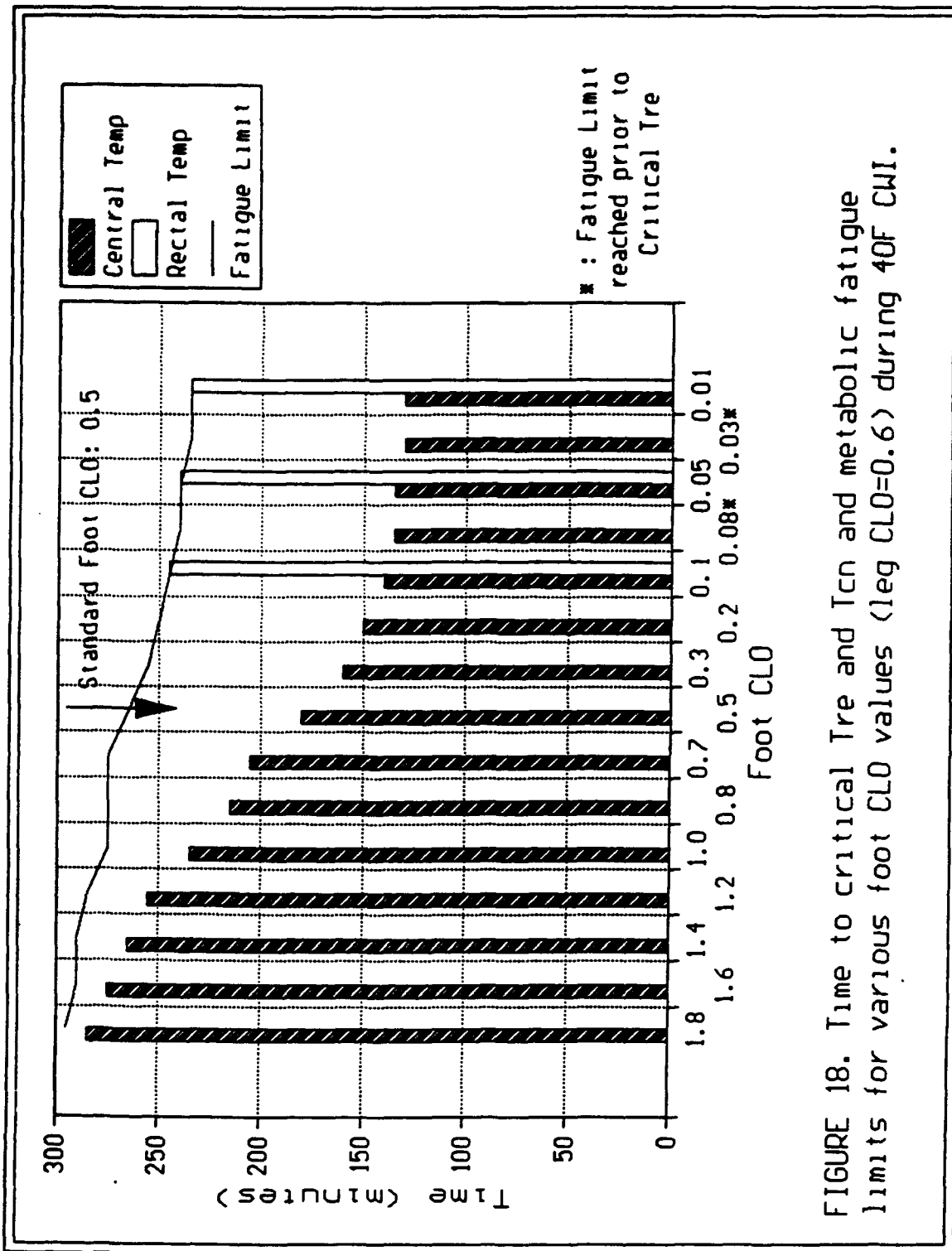
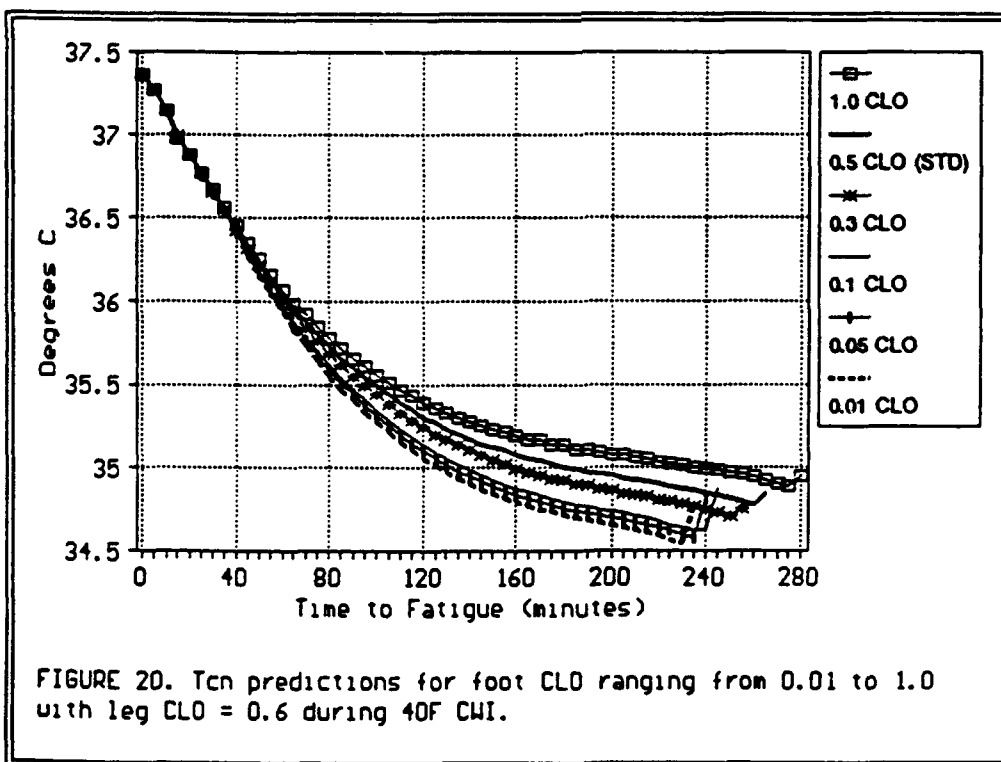
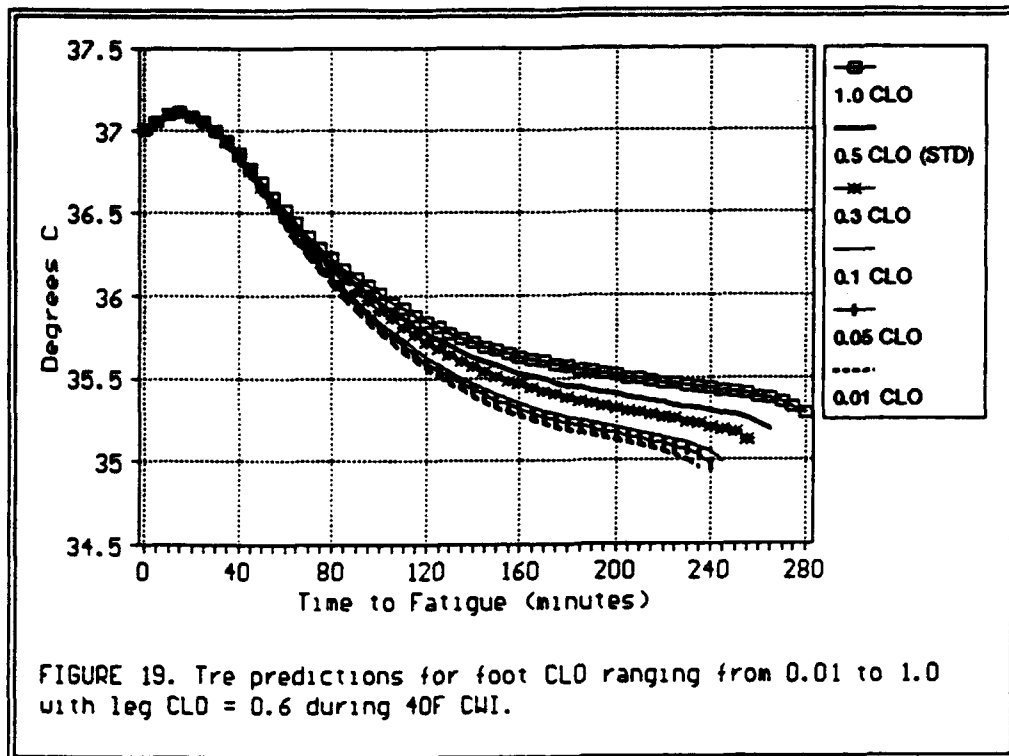
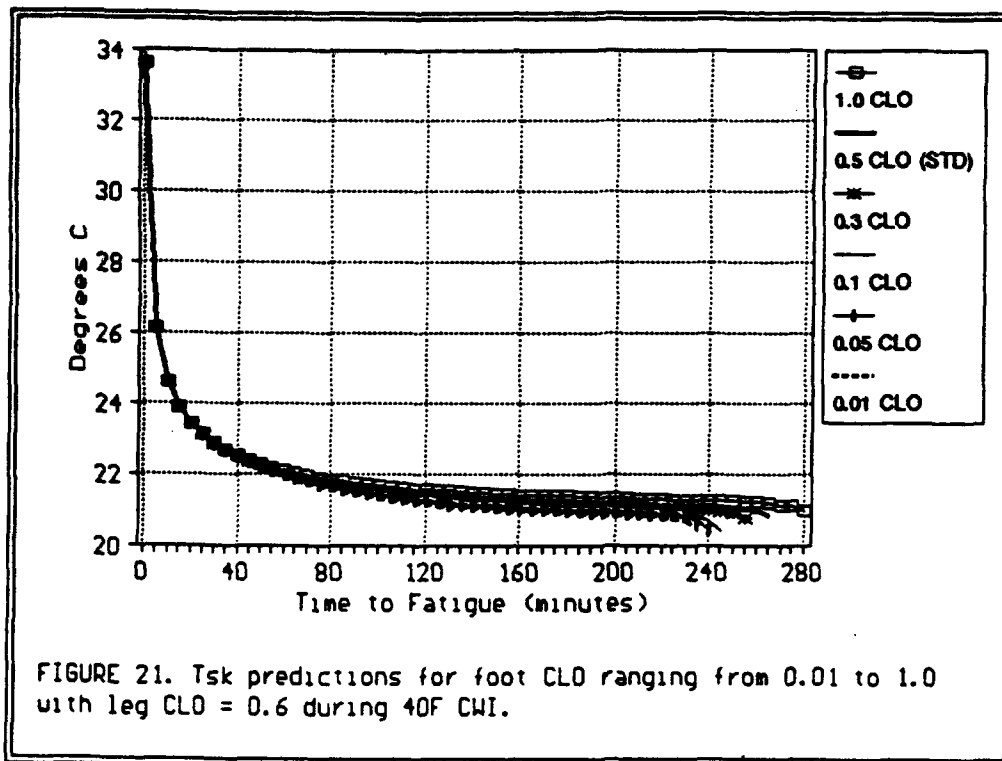


FIGURE 18. Time to critical Tre and Tcn and metabolic fatigue limits for various foot CLO values (leg CLO=0.6) during 40F CWI.





5. Arm and hand segment

a. For all cases, T_{re} and T_{sk} did not reach critical levels. See Table 15 for a summary of fatigue times and thermal predictions for the end of the CWI for Cases 1 to 3.

b. Results Case 1 (arm = hand CLO):

With an arm and hand CLO greater than 0.3, 6 hour CWI was completed without fatigue at 40°F. Figure 22 shows a plot of arm and hand CLO vs time to fatigue at 40°F indicating a fairly linear drop at 0.3 CLO and below. The greatest drop was between 0.1 and 0.3 CLO, during which the time to fatigue dropped by 70 minutes, compared to a 50 minute drop at CLOs between 0.01 and 0.1. Overall, between 0.01 and 0.3 CLO, time to fatigue decreased by 40 minutes for every 0.1 drop in CLO. Fatigue was reached after 335 minutes at 0.3 CLO and after 215 minutes at 0.01 CLO. A linear regression of arm and hand CLO versus time to fatigue is described by

$$\text{Time to fatigue} = 396.7x + 221.0 \quad r^2 = 0.98$$

where x = arm and hand CLO (other segment CLOs held at standard values).

Using this linear model, one would need to increase arm and hand CLO to 0.35 (350% increase), while holding other segments at standard CLO values, in order to complete 360 minutes at 40°F without fatigue. Figures 23-25 contain plots of T_{re} , T_{cn} and T_{sk} for CLO values from 0.01 and 0.3. As with the other segments, the greatest variation in temperatures occurred between 0.1 and 1.0 CLO.

c. Results Case 2 (Vary arm and fix hand at 0.1 CLO):

Case 2 results were very similar to Case 1 except that with a 0.4 arm CLO, fatigue limit was reached just at the end of the 6 hour run. At CLO values greater than 0.4, 6 hour immersion runs were completed without fatigue. With the exception of the 0.4 arm CLO run, fatigue times were identical between Cases 2 and 1. However, Case 2 T_{cn} fell to 35°C or below somewhat later than in Case 1 (an average of 10 minutes later) prior to fatigue at CLO values of 0.3 or less.

d. Results Case 3 (Vary hand and hold arm at 0.1 CLO):

Case 3 results were quite different from Cases 1 and 2. For hand CLO values of 0.15 or less, fatigue was always reached after 265 minutes while immersed in 40°F water. Therefore, it was found that, as anticipated, increasing hand CLO alone has no effect on the overall ability to tolerate 40°F cold water immersion. Figures 26-28 contain plots of T_{re} , T_{cn} and T_{sk} for the different CLO values tested. There was very little variation in all temperatures at the tested hand CLOs.

e. Results Case 4 (Vary hand and arm):

i. The results with setting arm CLO at 0.4, 0.8, 1.2, 1.6 and 2.0 while varying the hand CLO as in Case 3 were very similar to Case 1. Both T_{cn} and T_{re} remained above 35°C and fatigue limits were not reached after 6 hours. (At 0.4 arm CLO, fatigue actually occurred at 360 minutes). At arm CLO less than 0.4, the results were essentially the same as in Case 1 with at most a 5 minute variance in time for T_{cn} to reach 35°C. Therefore, the effect of varying hand CLO on immersion time is minimal.

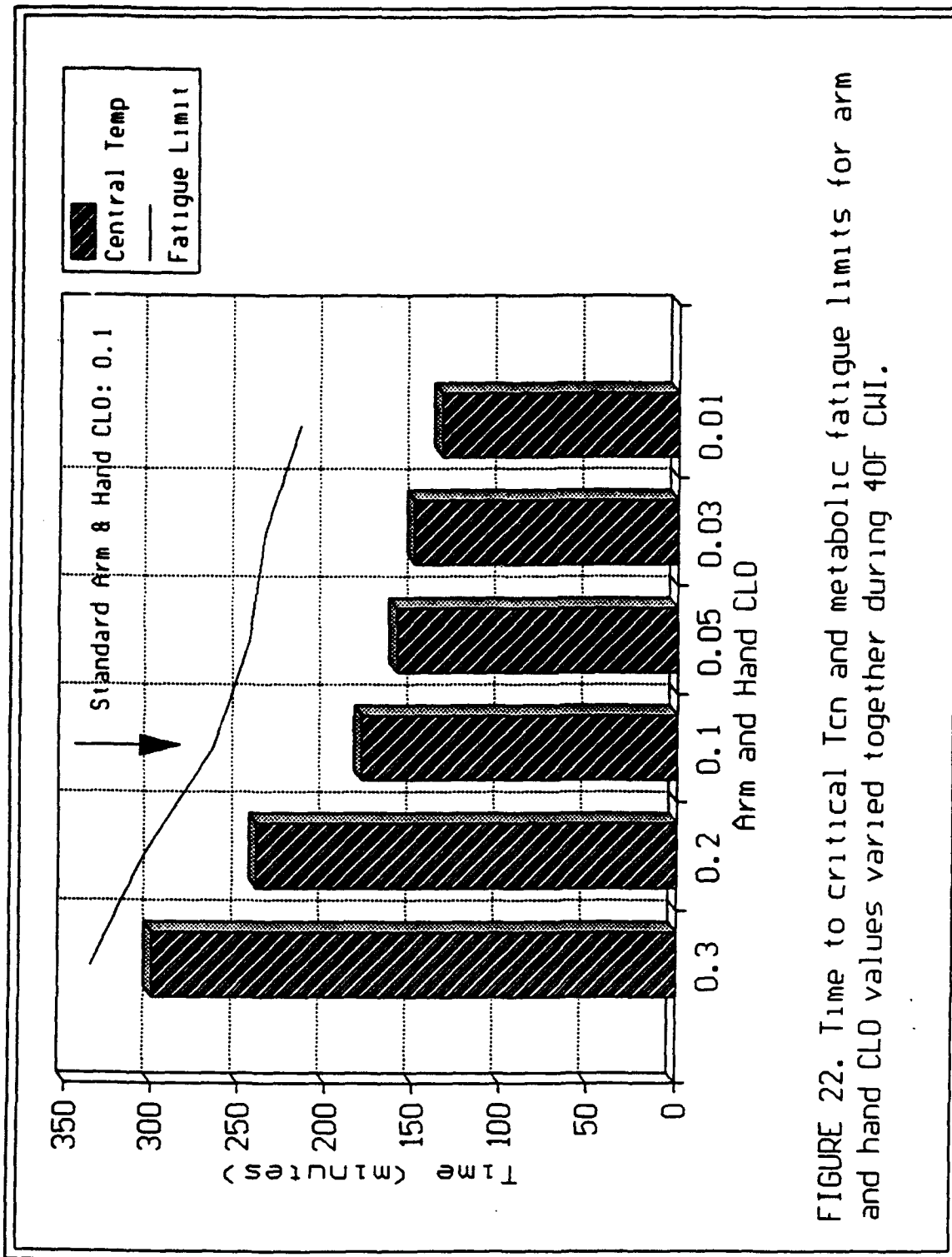
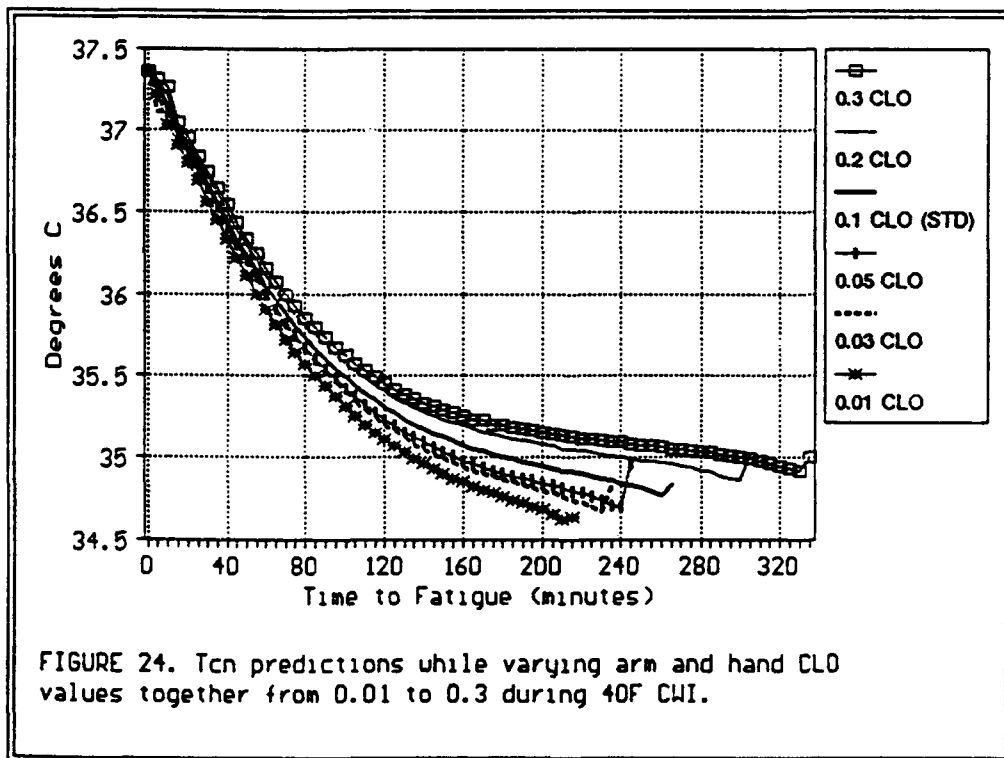
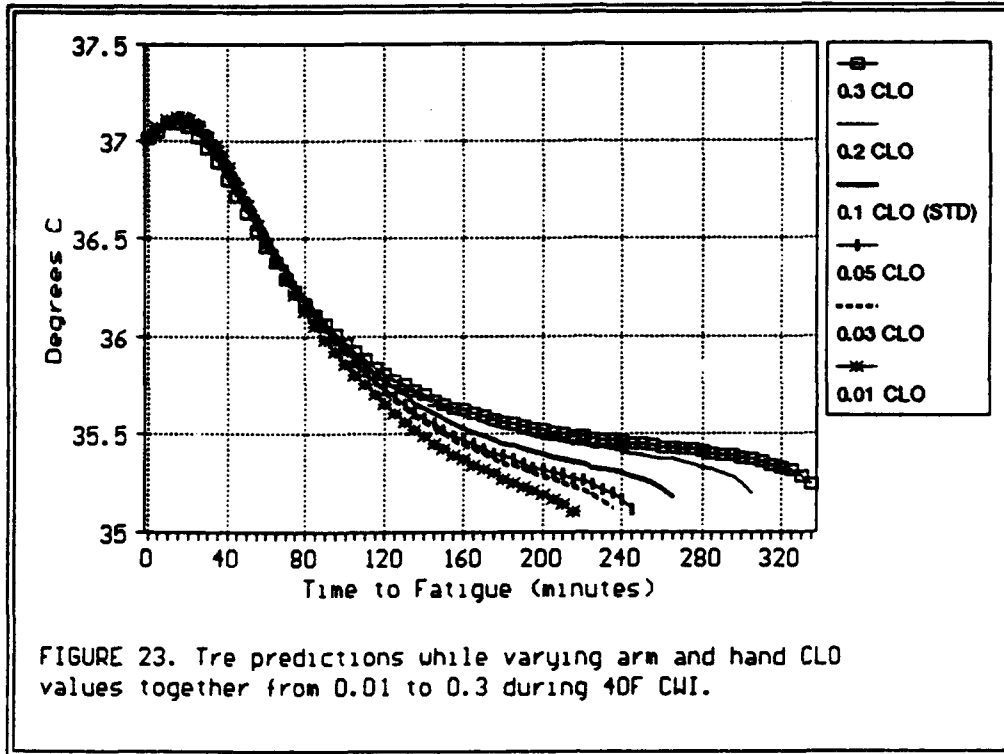


FIGURE 22. Time to critical Tcn and metabolic fatigue limits for arm and hand CLO values varied together during 40F CWI.



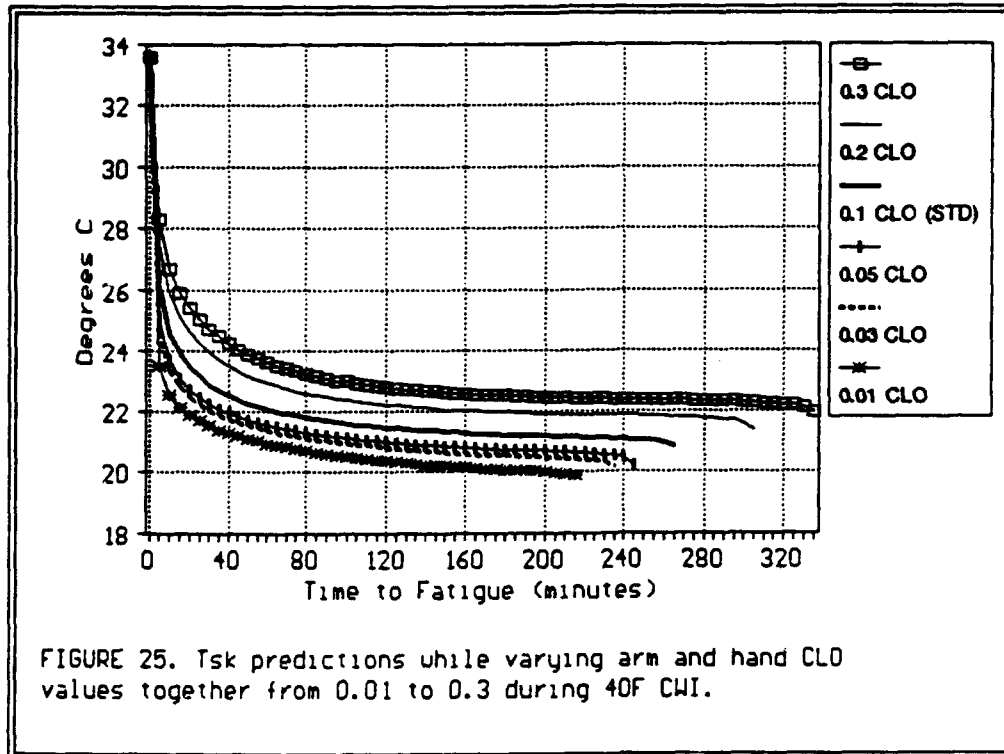


FIGURE 25. Task predictions while varying arm and hand CLO values together from 0.01 to 0.3 during 40F CWI.

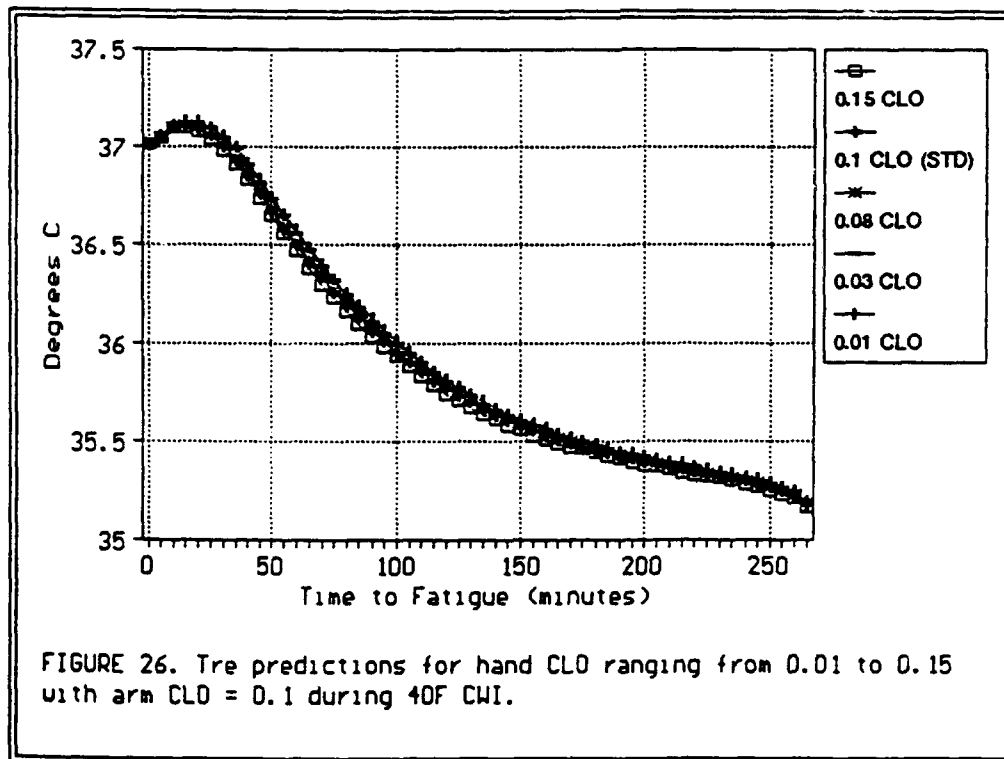
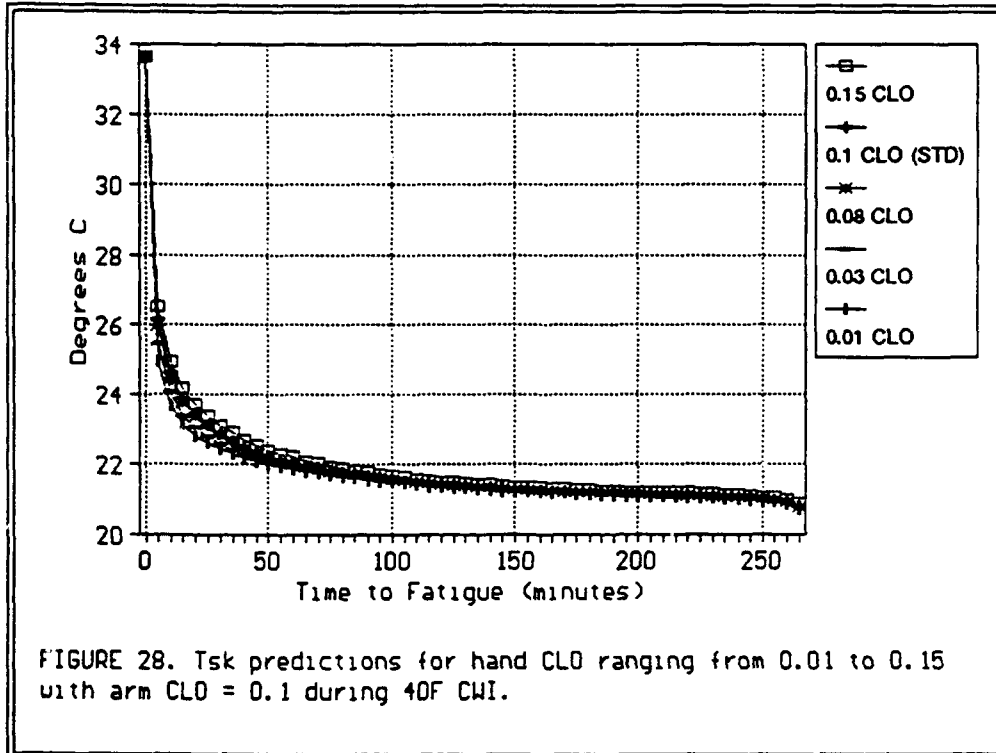
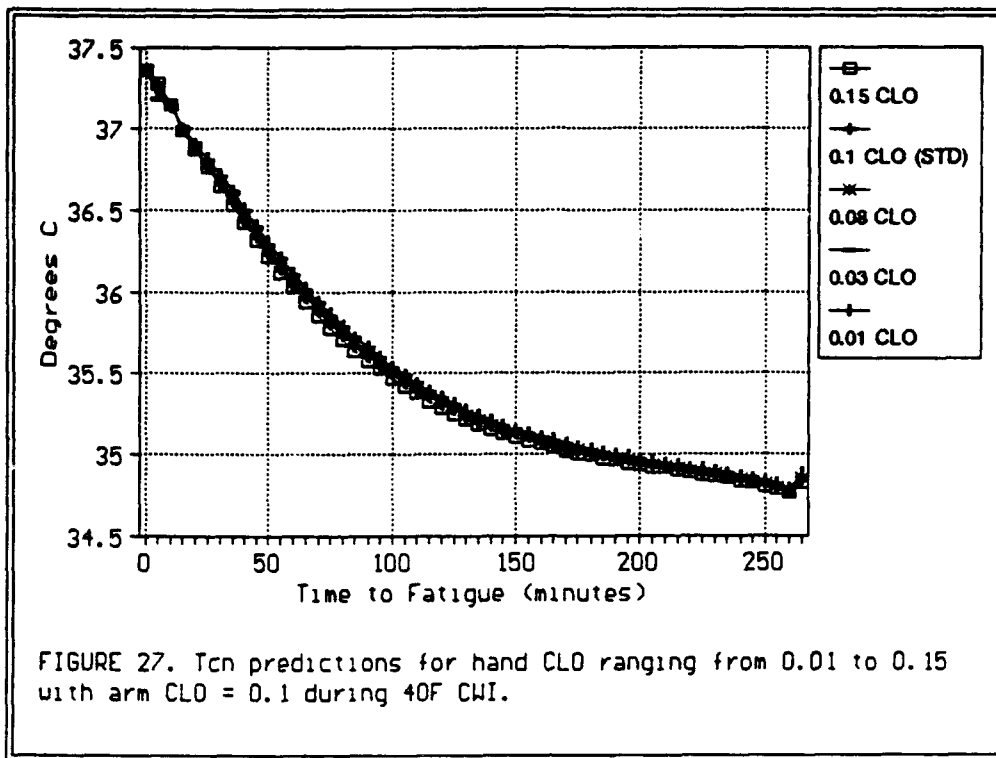


FIGURE 26. The predictions for hand CLO ranging from 0.01 to 0.15 with arm CLO = 0.1 during 40F CWI.



CLO	CASE 1 (arm = hand)				CASE 2 (vary arm)			
	T _{cn} (min)	Time to fatigue (min)	T _{re} at EOI (°C)	T _{sk} at EOI (°C)	T _{cn} (min)	Time to fatigue (min)	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
2.0	nf	nf	35.3	25.1	nf	nf	35.7	23.9
1.6	-	-	-	-	nf	nf	35.7	23.7
1.5	nf	nf	35.4	24.6	-	-	-	-
1.2	-	-	-	-	nf	nf	35.6	23.5
1.0	nf	nf	35.4	24.0	-	-	-	-
0.8	-	-	-	-	nf	nf	35.6	23.1
0.5	nf	nf	35.4	22.9	-	-	-	-
0.4	-	-	-	-	*	360	35.3	22.0
0.3	300	335	35.2	22.0	320	335	35.3	21.7
0.2	240	305	35.2	21.4	255	305	35.2	21.3
0.1	180	265	35.2	20.8	180	265	35.2	20.8
0.05	160	245	35.1	20.2	155	245	35.1	20.3
0.03	150	235	35.1	20.2	-	-	-	-
0.01	135	215	35.1	19.9	-	-	-	-

CLO	CASE 3 (vary hand)			
	T _{cn}	Time to fatigue (min)	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
0.15	175	265	35.2	20.9
0.1	180	265	35.2	20.8
0.08	185	265	35.2	20.8
0.03	190	265	35.2	20.8
0.01	190	265	35.2	20.7

TABLE 15. Time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) for various arm and hand CLO values. nf: no fatigue after 6 hours; *: The Model predicted fatigue before reaching critical temperature; -: CLO value not tested during that case. Standard arm and hand CLO = 0.1.

6. Head segment

a. Temperature predictions with and without a helmet are summarized in Table 16. Fatigue T_{cn} and T_{re} without helmets were equivalent at 28 and 40°F. Also, the difference in T_{cn} and T_{re} between the standard and the no helmet condition were relatively small. However, comparable T_{sk} between standard and no helmet conditions were greater. This indicated the important contribution the head segment made to predicted T_{sk}.

Water Temp	Condition	Time to Critical Temp		Time to Fatigue	Fatigue Temp (°C)		
		T _{re}	T _{cn}		T _{re}	T _{cn}	T _{sk}
28°F	No helmet	125	75	135	34.9	34.4	17.3
28°F	Helmet	*	105	165	35.1	34.5	18.1
40°F	No helmet	205	110	210	35.0	34.4	20.3
40°F	Helmet	*	180	265	35.2	34.8	21.0

TABLE 16. Time (minutes) to reach critical temperatures and fatigue and temperatures during 40°F CWI just prior to fatigue with or without wearing the standard USAF helmet.

*: The Model predicted fatigue before reaching critical temperature.

B. Physical, exercise and environmental characteristics assessment

1. Weight:

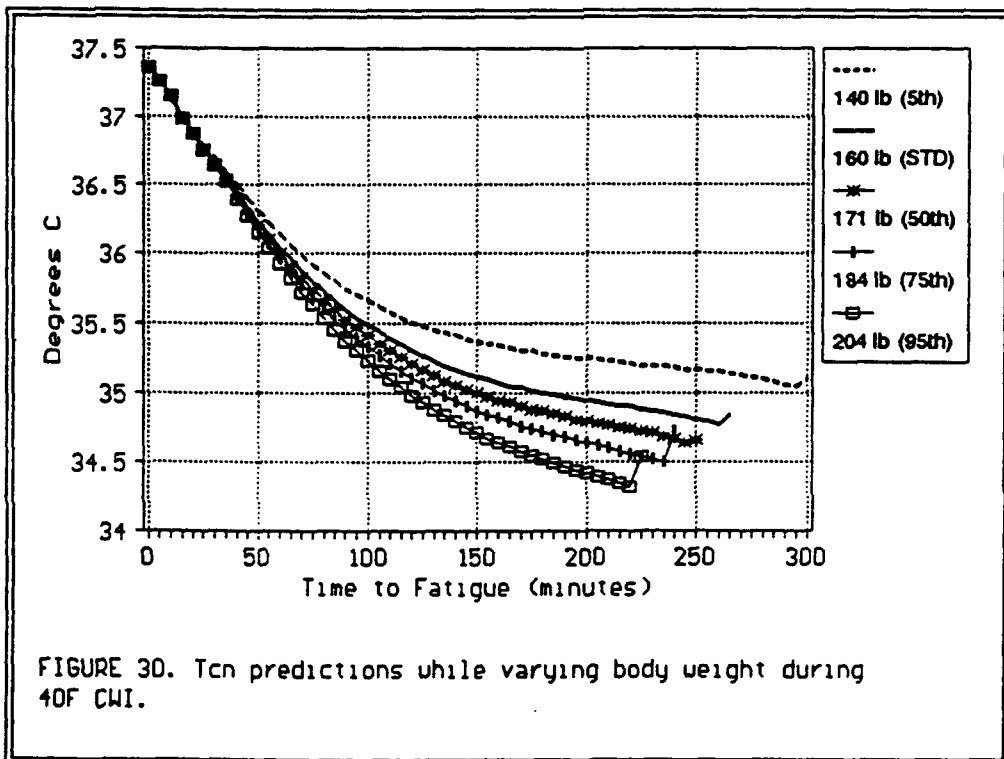
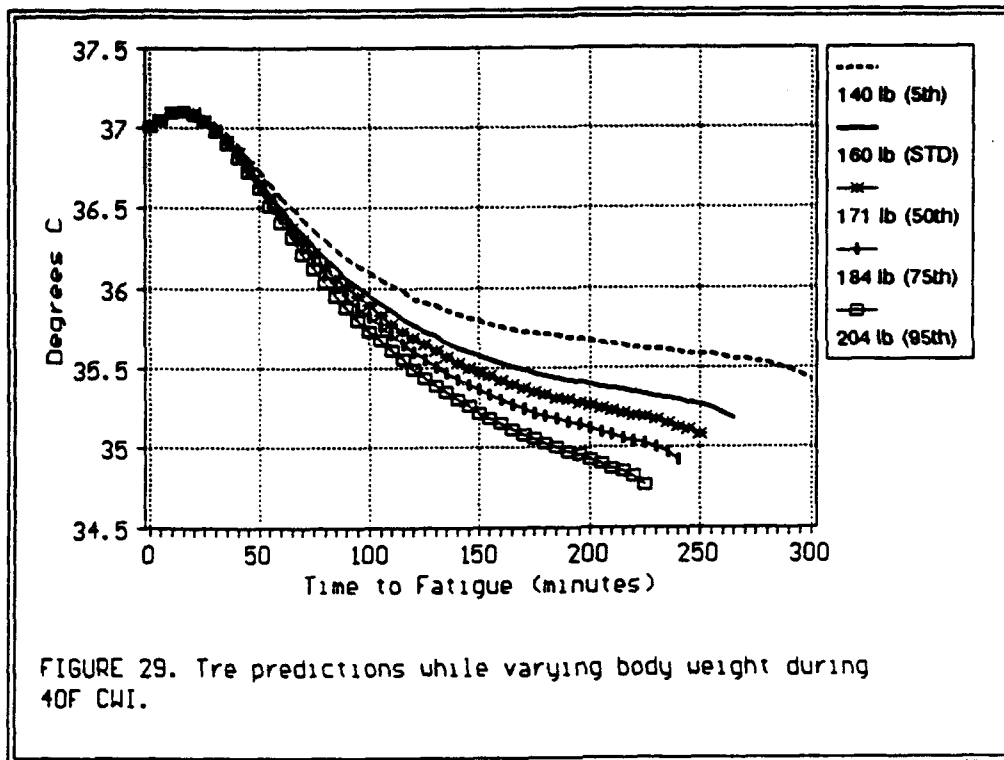
a. Table 17 summarizes the effects of increasing weight on time to reach critical temperatures and fatigue, as well as heart rate and temperatures at fatigue. T_{sk} did not reach a critical level during these runs. The Model calculated a variety of parameters which described the ability of the hypothetical man to store and remove heat. While changing body segment CLO values did not effect these parameters, changing physical characteristics did. Segmental heat transfer coefficients (HTC) were calculated by the Model to describe how adjacent structures within the body exchanged heat with one another, e.g. between arterial and venous blood pools. Standard values for HTC in 40°F water are given in Table 18. HTC were 2% greater at weights below 160 lb and were 1% lower for the 50th percentile, 2% lower for 75th percentile and 3.5% lower for the 95th percentile. The Model also calculated the rate at which heat was lost through the skin. At weights below 160 lb, skin heat loss rate was lower by approximately 3.5%, while above 160 lb, skin heat losses increased up to 6% for the 95th percentile. (Standard skin heat loss rate for the standard test condition ranged from 549 kcal/min at 5 min in 40°F to 341 kcal/min at fatigue). The ability of the body to store heat was also estimated and was effected by body weight. The stored heat content of the modelled 5th percentile subject averaged 12% less than at 160 lb, while the 95th percentile subject averaged 27% higher. (Standard stored heat content for the 160 lb subject ranged from 2246 kcal at immersion into 40°F to 1928 kcal at fatigue).

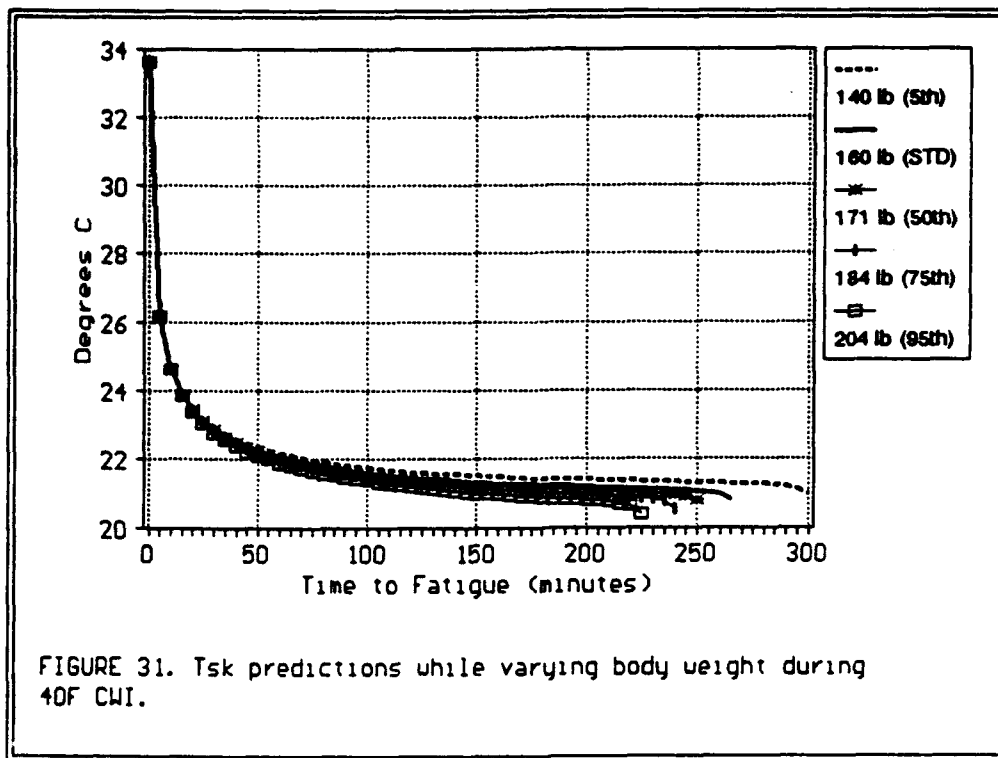
b. At all tested body weights, 6 hour CWI were not completed prior to fatigue. Time to fatigue decreased in a linear fashion, as described by the regression line

$$\text{Time to fatigue} = -1.15 x + 454.1 \quad r^2 = 0.95$$

where x = weight (other parameters held at standard values).

Figures 29-31 contain plots of T_{re}, T_{cn} and T_{sk} predictions for various body weights. T_{sk} was effected to a lesser extent than T_{re} and T_{cn}. For example, the fatigue level T_{sk} only ranged from 21.1°C (at 140 lb) to 20.6°C (at 204 lb). In sum, individuals with lower weights are predicted to tolerate CWI longer than heavy people.





Weight (lb)	T _{re} (min)	T _{cn} (min)	Time to Fatigue (min)	Initial HR	Max HR	Time to Max HR	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
140	*	*	300	59	83	205	35.4	21.0
160	*	180	265	65	85	200	35.2	20.8
171	*	155	250	66	86	195	35.1	20.8
184	230	135	240	66	87	190	34.9	20.5
204	185	120	225	70	88	180	34.8	20.4

TABLE 17. Heart rates and time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) with varying weights. Standard weight was 160 lb. *: The Model predicted fatigue before reaching critical temperature.

Body Segment	HTC (watt / m ² °C)	Body Segment	HTC (watt / m ² °C)
chest	988.7	hand	1632.1
abdomen	1049.4	thigh	1807.7
head	6.97	calf	1924.3
biceps	1241.8	foot	2248.8
forearm	1565.1		

TABLE 18. Standard test condition body segment heat transfer coefficients.

2. Mean Skinfold Thickness (MST):

a. As MST increased, predicted time to fatigue and starting heart rate increased and maximum heart rate decreased. All segment HTC, surface and skin heat losses increased at MST < 10 mm and decreased at MST > 10 mm. Stored heat content decreased at MST < 10 mm and increased at MST > 10 mm. Respiratory heat loss was less than standard at MST = 3 or 5 mm and about the same at MST ranging from 8 to 15 mm. See Table 19 for a summary of results.

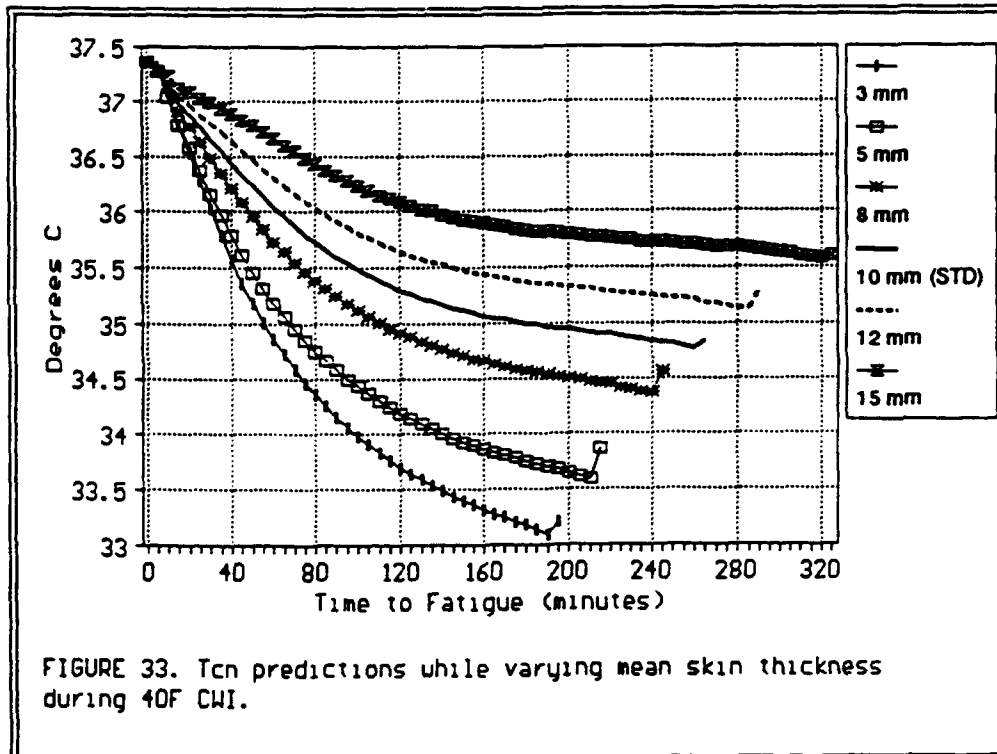
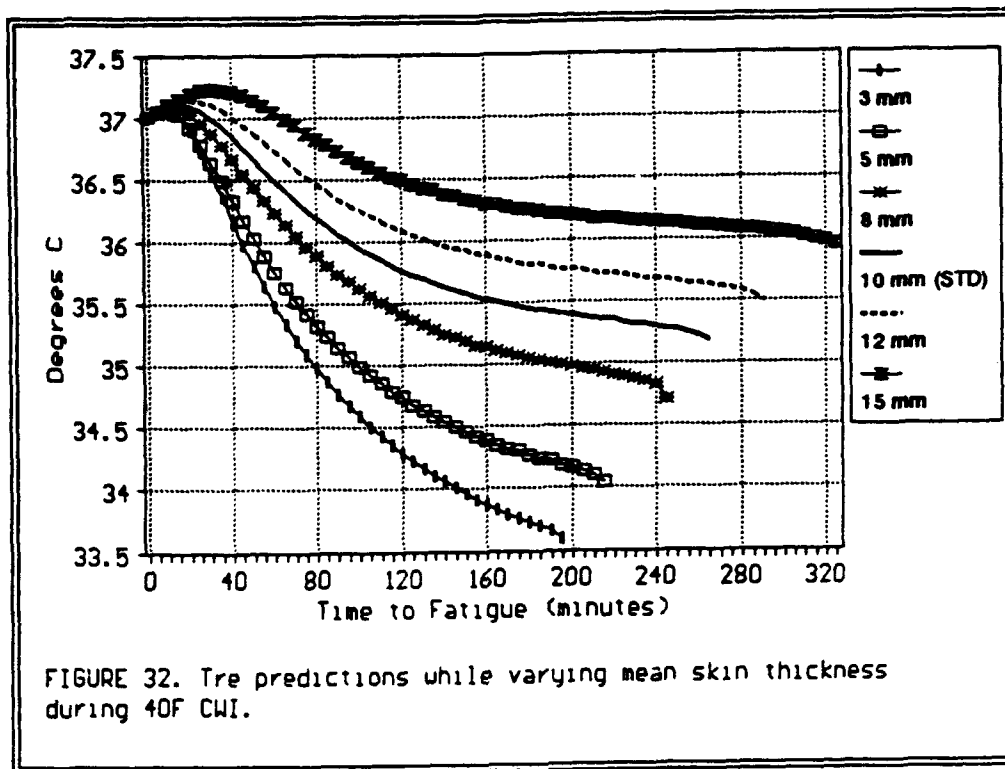
b. At all tested weights, 6 hour CWI were not completed prior to fatigue. However, the higher the MST, the longer it took to reach fatigue, increasing in a linear fashion. A linear regression line describing the function is given by:

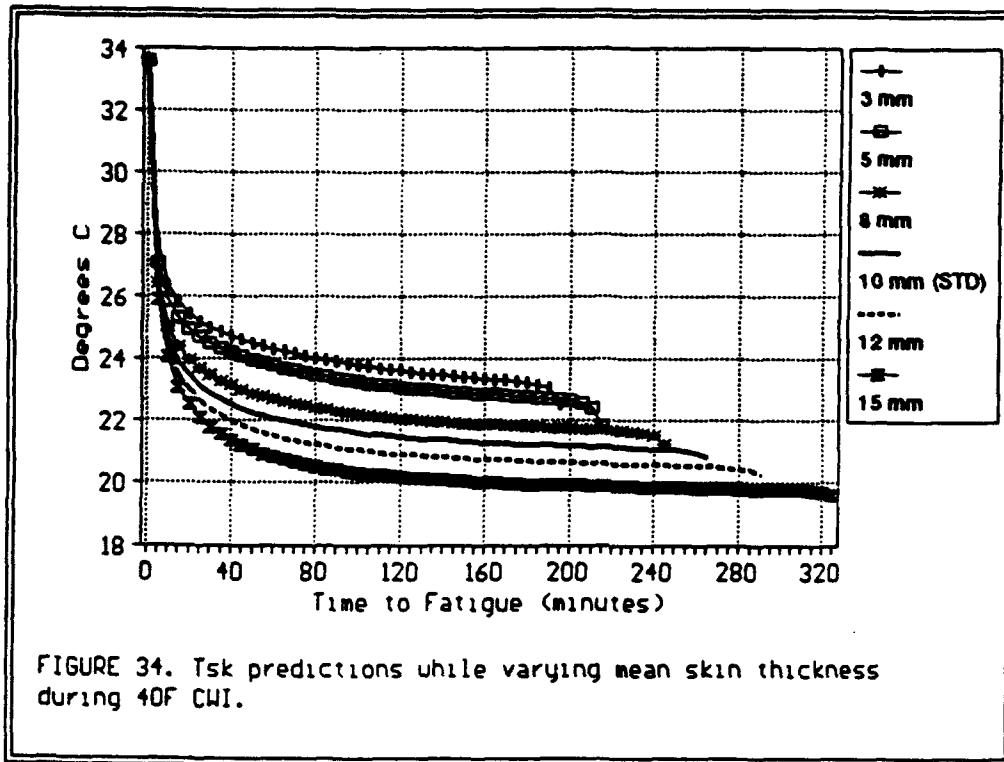
$$\text{Time to fatigue} = 10.78 \times \text{MST} + 160.6 \quad r^2 = 0.99$$

where x = MST (other parameters held at standard values).

Based on this regression, a MST of at least 18.6 mm would be required to complete 360 minutes in 40°F water without reaching fatigue under the standard test conditions.

c. Figures 32-34 contain plots of T_{re}, T_{cn} and T_{sk}. As MST increased, T_{re}, T_{cn} and time to fatigue increased while T_{sk} decreased. T_{sk} did not fall to critical levels during these runs. Note that fatigue level temperatures were relatively evenly distributed with respect to MST.





MST (mm)	T _{re} (min)	T _{cn} (min)	Time to Fatigue (min)	Initial HR	Max HR	Time to Max HR	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
3	80	60	195	64	90	165	33.6	22.5
5	100	70	215	64	88	170	34.0	21.8
8	195	115	245	65	86	185	34.8	21.2
10	*	180	265	65	85	200	35.2	20.8
12	*	*	290	65	84	205	35.5	20.2
15	*	*	325	66	83	235	36.0	19.7

TABLE 19. Heart rates and time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) with varying mean skinfold thicknesses. Standard MST was 10 mm. *: Model fatigued before reaching critical temperature.

3. Basal Metabolic Rate (BMR):

a. As BMR increased, estimated starting and maximum heart rate increased. The Model calculated the overall rate at which heat was generated for a given test condition, including metabolic sources and the level of physical activity, including shivering. Heat generation increased as long as shivering was maintained and dropped precipitously once the ability to shiver was lost. The maximum rate of heat generation was 5% lower than the standard test condition at BMR = 50 watts and slightly greater than standard at BMR greater than 100 watts (e.g. 2% higher at 150 watts). T_{sk} did not fall to critical levels during these runs. Table 20 contains a summary of the results.

b. A 6 hour CWI was completed with BMR of 200 watts. Time to fatigue was linearly related to BMR as given by

$$\text{Time to fatigue} = 1.45 x + 131.67$$

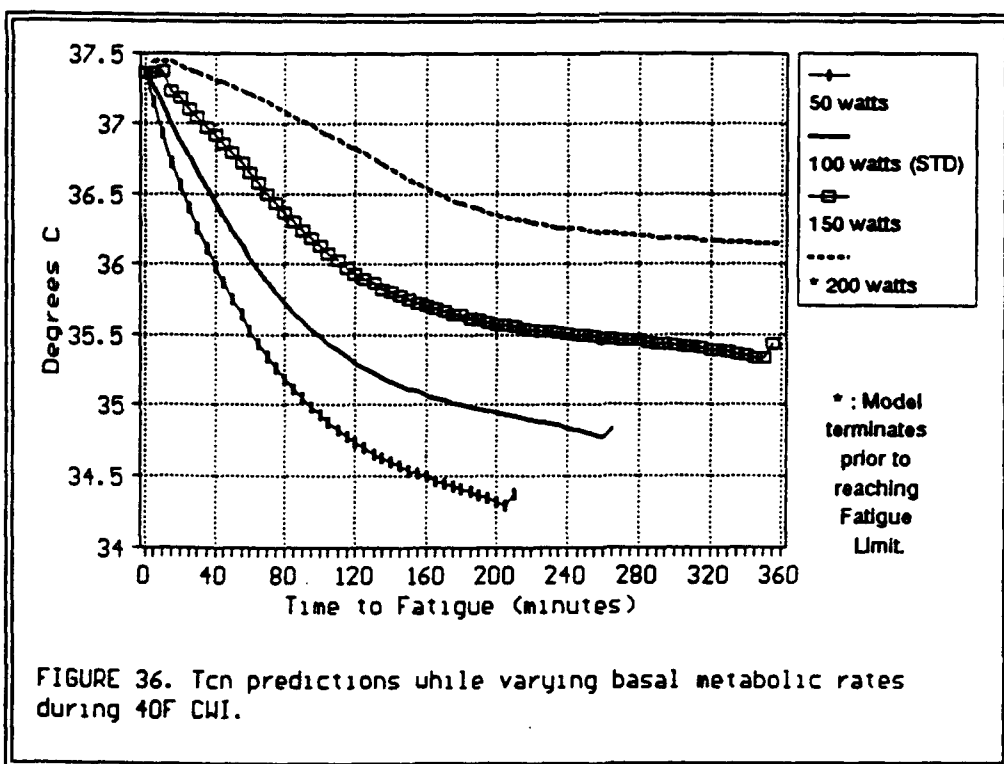
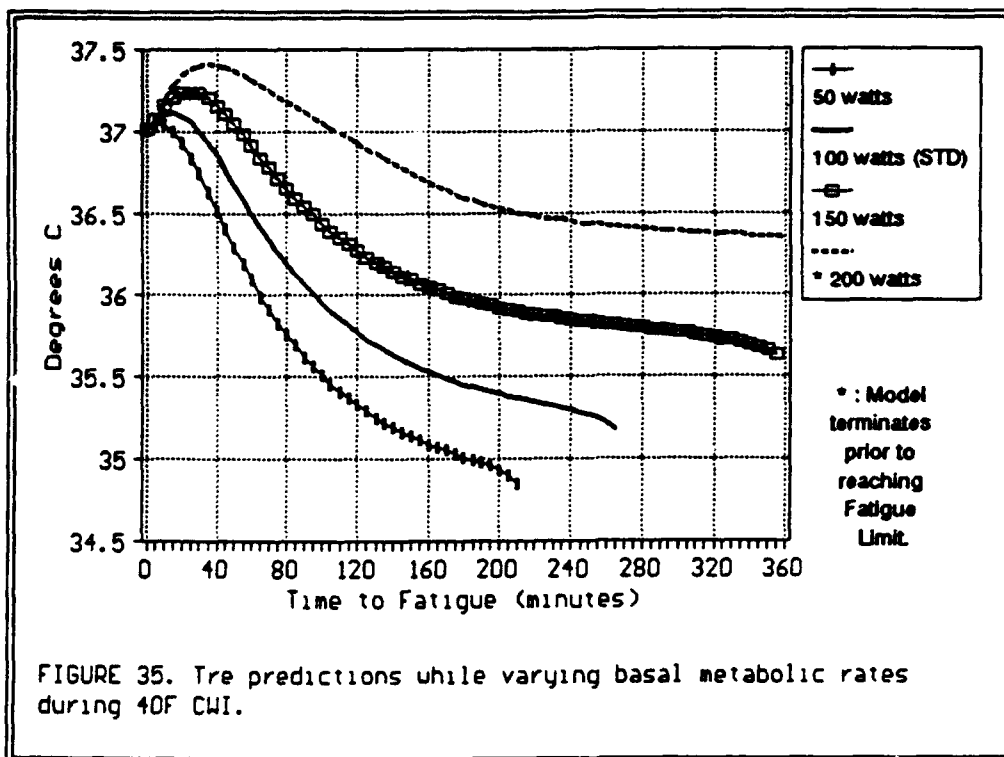
$$r^2 = 0.98$$

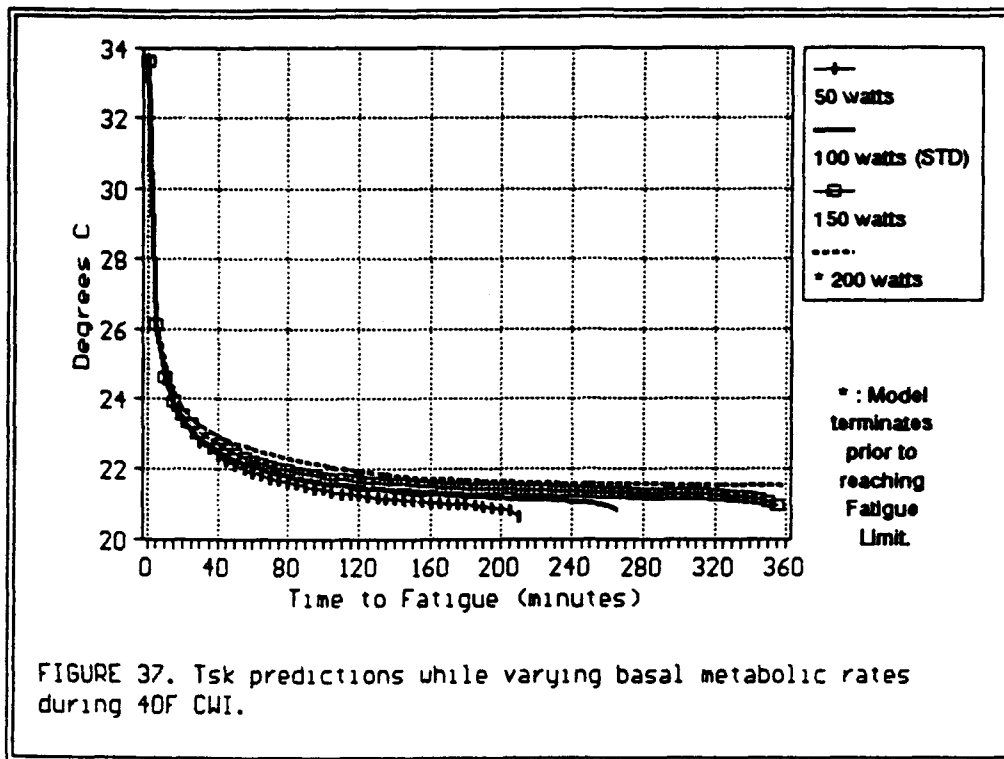
where x = BMR (other parameters held at standard values).

According to this equation, six hour CWI could be withstood without reaching fatigue with a BMR of at least 159 watts under standard test conditions. Figures 35-37 contain plots of T_{re}, T_{cn} and T_{sk}. Note that T_{cn} and T_{re} at fatigue were relatively evenly distributed with respect to BMR. The fatigue level T_{sk} showed less variation than the other temperatures - ranging from 20.8°C (at 50 watts) to 21.5°C (at 200 watts).

BMR (watts)	T _{re} (min)	T _{cn} (min)	Time to Fatigue (min)	Initial HR	Max HR	Time to Max HR	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
50	185	95	210	60	80	170	34.9	20.7
100	*	180	265	65	85	200	35.2	20.8
150	*	*	355	71	91	240	35.6	21.0
200	nf	nf	nf	71	97	290	36.4	21.5

TABLE 20. Heart rates and time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) while varying basal metabolic rate. Standard BMR was 100 watts. *: Model predicted fatigue before reaching critical temperature; nf: no fatigue after 6 hours.





4. Exercise Metabolic Rate (EMR):

a. As EMR increased, there was a point of inflection between 100 and 250 BTU/hr. At 250 and 500 BTU/hr, the time to fatigue apparently increased, while the Model stopped computations because the arterial temperature dropped to 32.5°C. This indicated that the modelled individual would be in serious danger. Yet at 750 and 1000 BTU/hr, the Model completed the 6 hour CWI. Because of the change in inflection of the fatigue times and the reversal of declining trend in T_{cn} and T_{re} critical temperature times, Model outputs at 250 BTU/hr and above under standard test conditions are of questionable accuracy. Table 21 contains a summary of the results.

b. Heat generation was estimated to be greater than the standard Model output at all EMR greater than 1 BTU/hr. Predicted skin heat loss increased as EMR increased. Only the HTC for the hand increased as EMR rose. Predicted T_{sk} remained above the 15°C limit for all tested EMR.

EMR (BTU/hr)	T_{re} (min)	T_{cn} (min)	Time to Fatigue (min)	Initial HR	Max HR	Time to Max HR	T_{re} at EOI (°C)	T_{sk} at EOI (°C)
1	*	180	265	65	85	200	35.2	20.8
50	*	135	250	62	87	190	35.0	21.1
100	230	120	245	65	89	190	34.9	21.1
250	190	100	275 +	67	94	180	33.4	19.7
500	245	100	295 +	68	100	185	33.7	20.8
750	335	140	nf	69	105	200	33.9	21.2
1000	nf	nf	nf	70	109	235	35.9	23.7

TABLE 21. Heart rates and time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) with varying exercise metabolic rates. Standard EMR was 1 BTU/hr. *: Model fatigued before reaching critical temperature; nf: no fatigue after 6 hours; +: Model reached 32.5°C arterial temperature and ceased computation.

5. Exercise Metabolic Distribution (EMD):

a. Absolutely no difference was demonstrated in any Model end point for any of the tested distributions under standard CLO and EMR conditions. Since negligible exercise was included in the standard Model conditions, to further test EMD, these runs were repeated using an exercise metabolic rate of 50 BTU/hr. Results from these tests are shown in Table 22. When the arms contributed a greater proportion to overall exercise metabolism relative to the legs, predicted time to fatigue shortened along with a decrease in T_{re} and T_{cn} and an increase in T_{sk} at fatigue. Time to reach critical T_{re} was also predicted to decrease. Simulating an increase in upper body exercise relative to the lower body (run D) differed slightly from standard distribution at 50 BTU/hr (difference in T_{re} at fatigue was only 0.1%).

EMD Class	T _{re} (min)	T _{cn} (min)	Time to Fatigue (min)	Initial HR	Max HR	Time to Max HR	T _{re} at EOI (°C)	T _{sk} at EOI (°C)
STD	*	180	265	65	85	200	35.2	20.8
STD50	*	135	250	62	87	190	35.0	21.1
A	239	125	244	66	88	195	35.0	21.2
B	225	110	240	65	88	190	34.9	21.2
C	210	115	236	65	88	190	34.9	21.2
D	246	130	247	65	88	190	35.0	21.1

TABLE 22. Heart rates (HR), time (minutes) to reach critical temperatures and fatigue and T_{re} and T_{sk} at the end of 40°F CWI (EOI) while varying EMD (defined in Table 11) with an EMR of 50 BTU/hr. STD: standard distribution; STD50: standard distribution at EMR = 50 BTU/hr; *: Model predicted fatigue before reaching critical temperature.

6. Wind speed (WSPD):

a. As WSPD increased, estimated time to fatigue remained at 265 minutes (at 10 mph and greater, fatigue occurred at 260 minutes). Predicted starting and maximum heart rates were essentially unchanged. All HTC were greater than standard - at 8 mph and above, the increase was at least twofold. Skin heat loss rate was slightly greater than under standard Model conditions. Loss of heat through the respiratory tract was unchanged. Critical T_{re} and T_{sk} were not reached prior to fatigue. T_{cn} reached 35°C after 180 minutes (4 and 6 mph) and 175 minutes (8 mph and above). Plots of these temperatures show essentially no effect of wind at these speeds during head-out immersion. Note that running the Model with a zero wind speed produced invalid results. Calculated CLO values were unreasonably large, essentially no shivering occurred during 6 hours of 40°F CWI, HTCs were very small, surface and skin heat loss and heat generation were very low and the Model predicted that sweat would be generated (Model variable SWEAT was non-zero).

b. In cold air environments, however, wind speed may become an important factor in an individual's ability to tolerate cold stress. The Model accounts for the lower thermal conductivity of air relative to water by increasing effective CLO values and reducing segment convective HTC. To accommodate the effects of increasing wind speed, the Model proportionately modulates these changes, resulting in smaller increases in CLO and less reduction in HTC. For example, the effective segment CLO values in water and air (wind speed at 2 mph) are as follows:

Segment:	Chest	Abdomen	Head	Arm	Hand	Leg	Foot
Wet CLO:	0.81	0.81	4.16	0.10	0.10	0.61	0.50
Air CLO:	1.40	1.39	4.85	0.55	0.50	1.15	0.98

With a 40 mph WSPD in air, effective segment CLO values became:

Segment:	Chest	Abdomen	Head	Arm	Hand	Leg	Foot
Air CLO:	0.91	0.91	4.26	0.18	0.17	0.70	0.59

7. Comparison of Model predictions at 28 and 40°F water temperatures

Figures 38-45 contain graphs of segment temperature change versus time to fatigue using the standard 62/P configuration, including arterial, head, chest, abdomen, upper arm, forearm, thigh and calf temperatures plotted at both water temperatures. The overall shapes of the curves at 28 and 40°F were essentially the same - except that the 28°F temperatures were lower and the time to fatigue was shorter than the 40°F run.

IV. DISCUSSION

A. Segment CLO Assessment

1. Estimated thermal end points were effected by changes in body segment CLO. When ordered from most to least sensitive, these were the chest and abdomen, leg, head, arm, foot and hand. As CLO values were reduced, the change in leg, chest and abdomen, and arm segment temperatures, T_{re} , T_{sk} and T_{cn} were fairly linearly distributed. Change in foot CLO values from 0.01 to 1.0 had relatively little effect on T_{sk} . Thermal endpoints based on foot insulation values were also less sensitive to very low CLOs (<0.1) as compared to the other body segments (excluding the hands). Varying hand CLOs between 0.01 to 0.15 had no effect whatsoever.

2. Based on Model predictions, one needed to increase lower limb insulation to a relatively smaller degree, as compared to the chest and abdomen, to achieve the 6 hour CWI goal. When related to standard CLO values, it required an increase in chest and abdomen CLO of 0.9 (113% increase) as compared to a 0.35 increase (350%) in arm and hand CLO and a 0.5 to 0.6 increase (83 to 100%) in leg CLO. An optimal distribution of insulation covering the various body regions would judiciously apply these results giving due consideration to the effects increased bulk would have on dexterity and comfort in flight.

3. The only segments in these CLO tests in which T_{sk} reached 15°C or less in 40°F water were the abdomen and chest, suggesting that the skin of the torso was less resistant to CWI than the limbs. However, the results from the head coverage runs indicated that the major drivers for T_{sk} were (in order) the head, the torso, then the legs. This result was somewhat surprising given that the Model used the Hardy-Dubois equation to calculate T_{sk} which uses a weighted sum given by

$$T_{sk} = 0.27 T_{chest} + 0.16 T_{thigh} + 0.16 T_{calf} + 0.11 T_{hand} + 0.09 T_{abdomen} + 0.07 T_{head} + 0.07 T_{biceps} + 0.07 T_{forearm}$$

B. Physical, Exercise and Environmental Characteristics Assessment

1. The Model was the most sensitive to changes in mean skinfold thickness in terms of its effect on both temperature magnitude and time to fatigue. As MST increased, so did the predicted ability to tolerate cold water stress. The Model estimated that an individual with a MST of 18.6 mm or greater would tolerate a 6 hour CWI under the standard conditions.

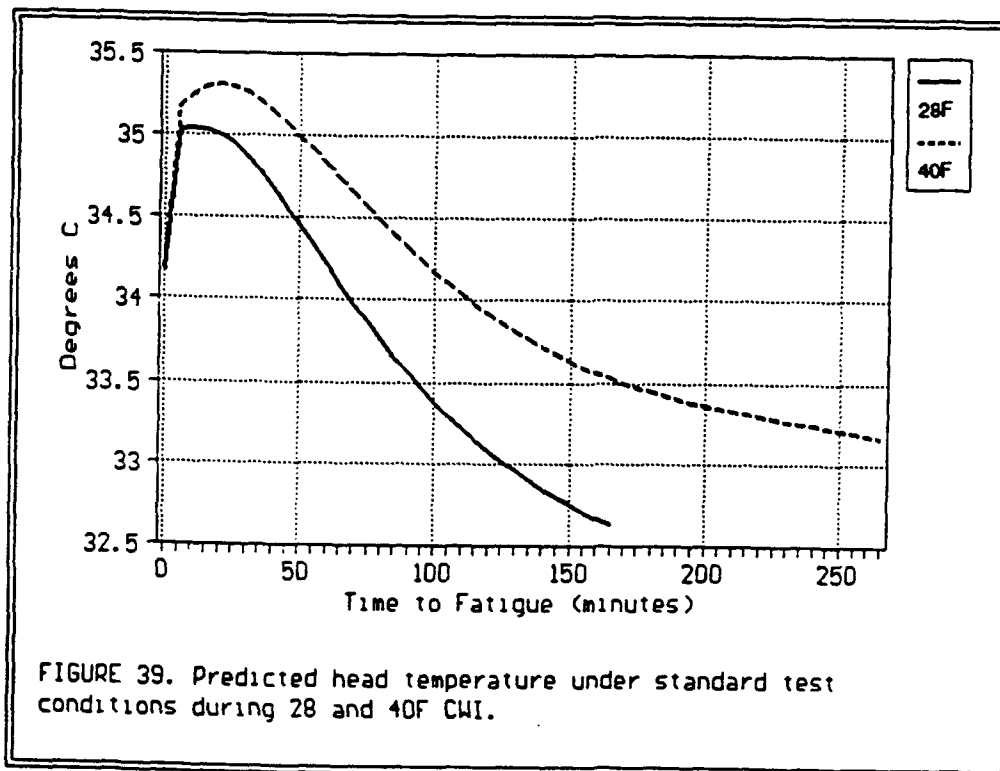
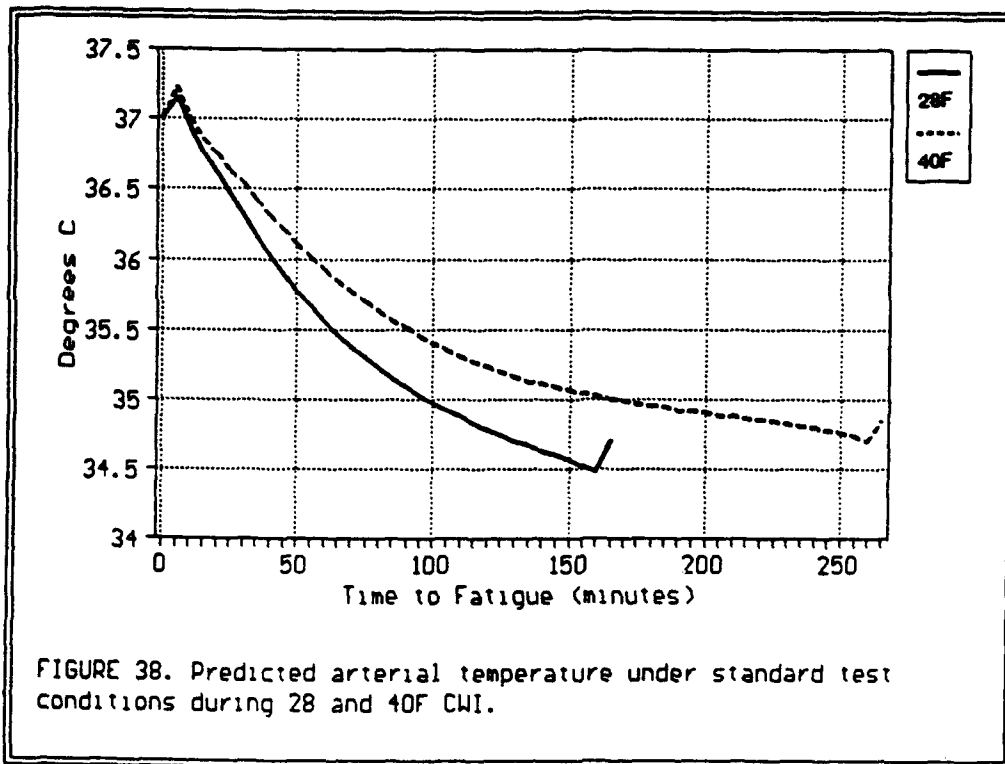
2. Increasing body weight reduced estimated cold water tolerance. For individuals in the 75th weight percentile, T_{re} was predicted to drop below critical levels while immersed in 40°F water, while the T_{re} of lighter weight people remained above 35°C. Predicted T_{sk} was relatively insensitive to changes in body weight. From the 5th to the 95th percentile, estimated T_{sk} only dropped by about 0.5°C. These results suggest that individuals with low body weight and high MST (such as females) should have a higher tolerance to CWI.

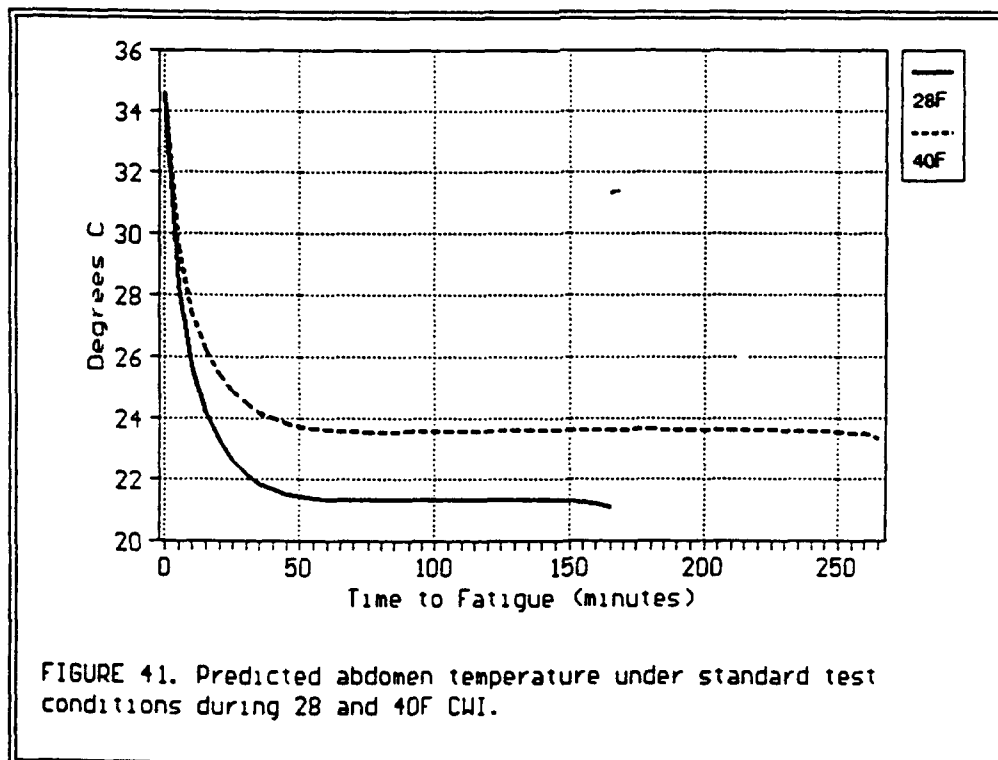
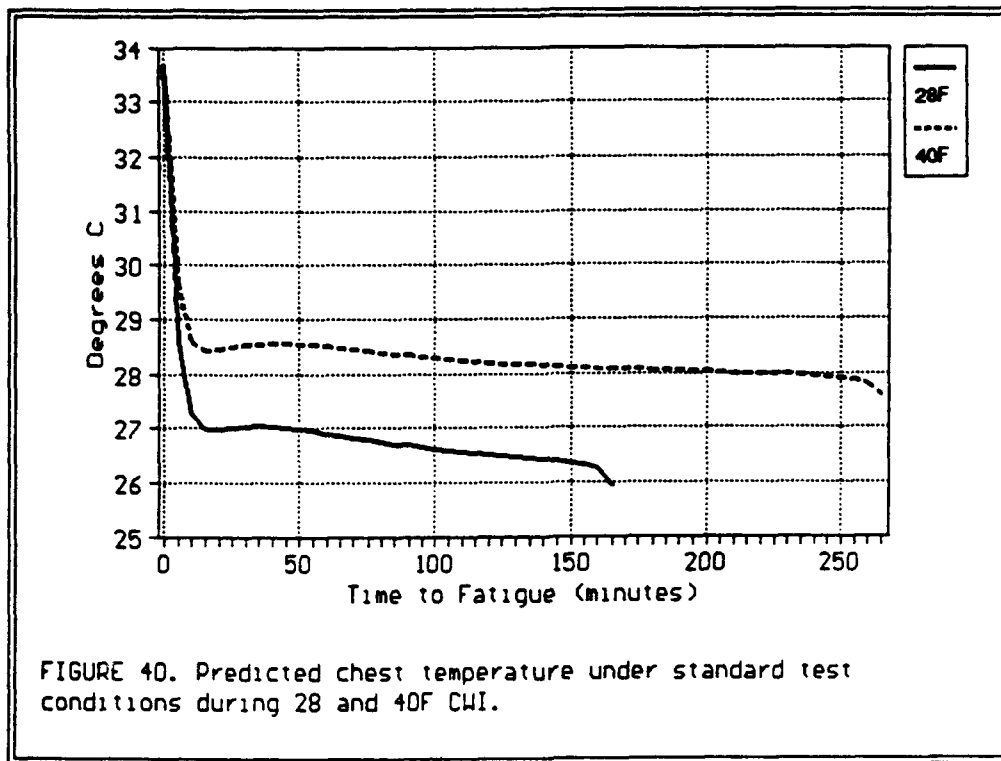
3. Since time to fatigue was directly related to the ability of the metabolism to continue to shiver, changes in basal metabolic rate also directly effected Model performance. As BMR increased, T_{re} and T_{cn} rose and 6 hour CWI could theoretically be withstood with a BMR of 159 watts. However, T_{sk} was relatively insensitive to changes in BMR. As BMR increased from 50 to 200 watts, T_{sk} only rose 0.7°C.

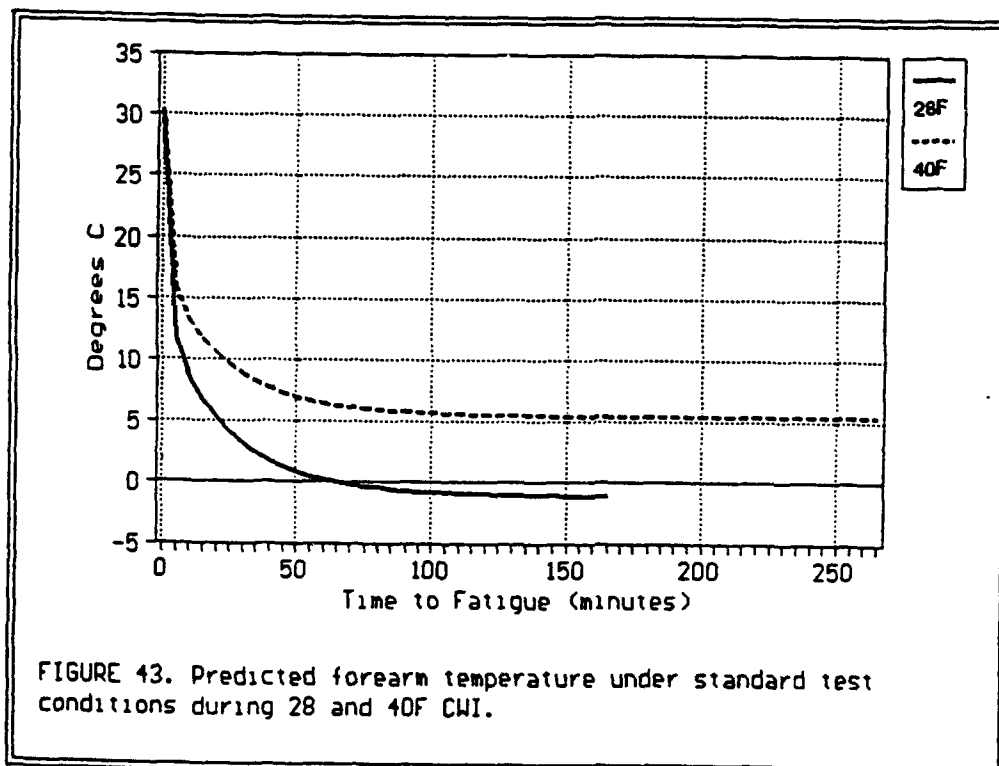
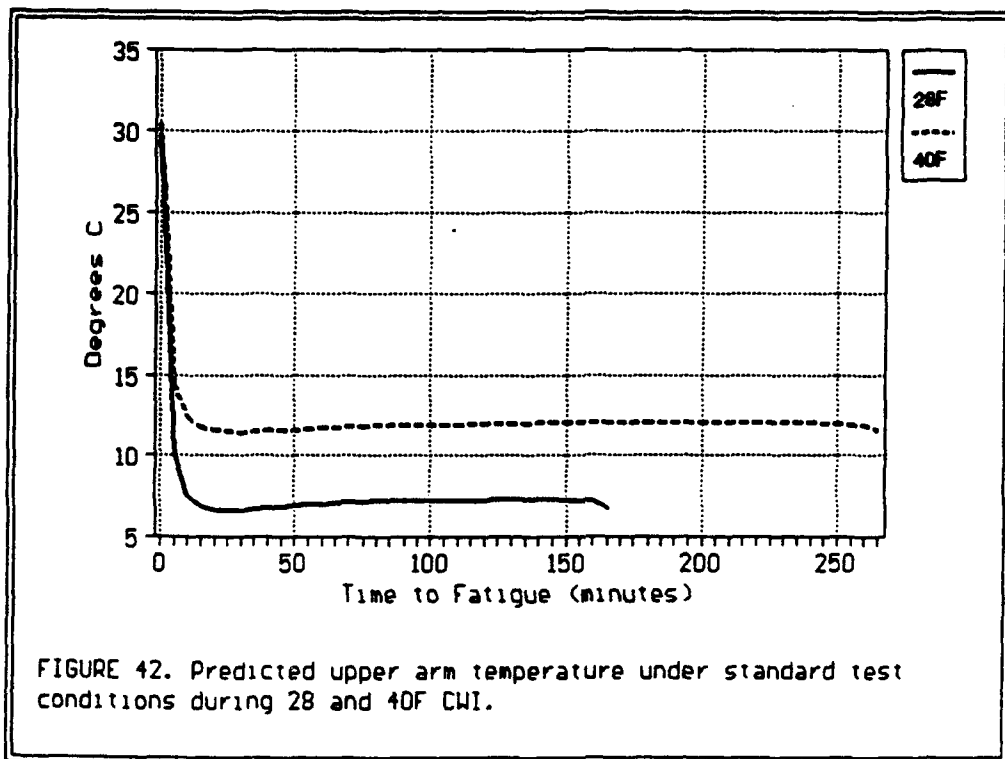
4. It was found that under the conditions tested in this study, one could not increase the simulated exercise metabolic rate beyond 100 BTU/hr with reliable results. As EMR was increased up to 100 BTU/hr, time to fatigue and T_{re} dropped. This was to be expected given that fatigue was tied directly to ability of the body to continue to shiver and generate heat internally. Therefore, a higher EMR may expend metabolic reserves more quickly as compared to the standard condition.

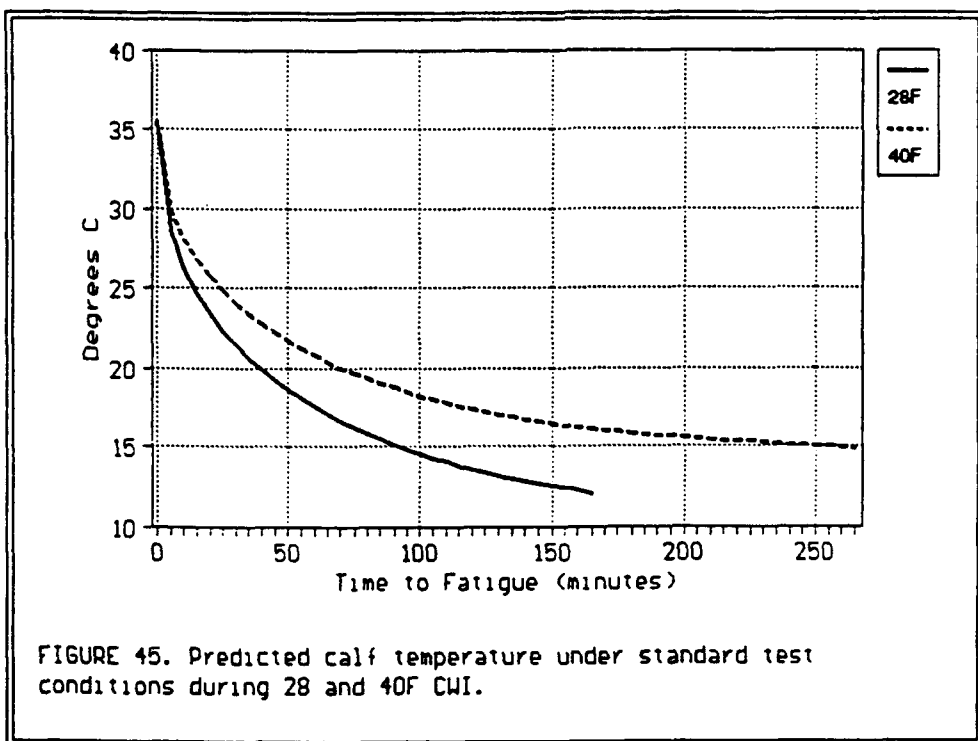
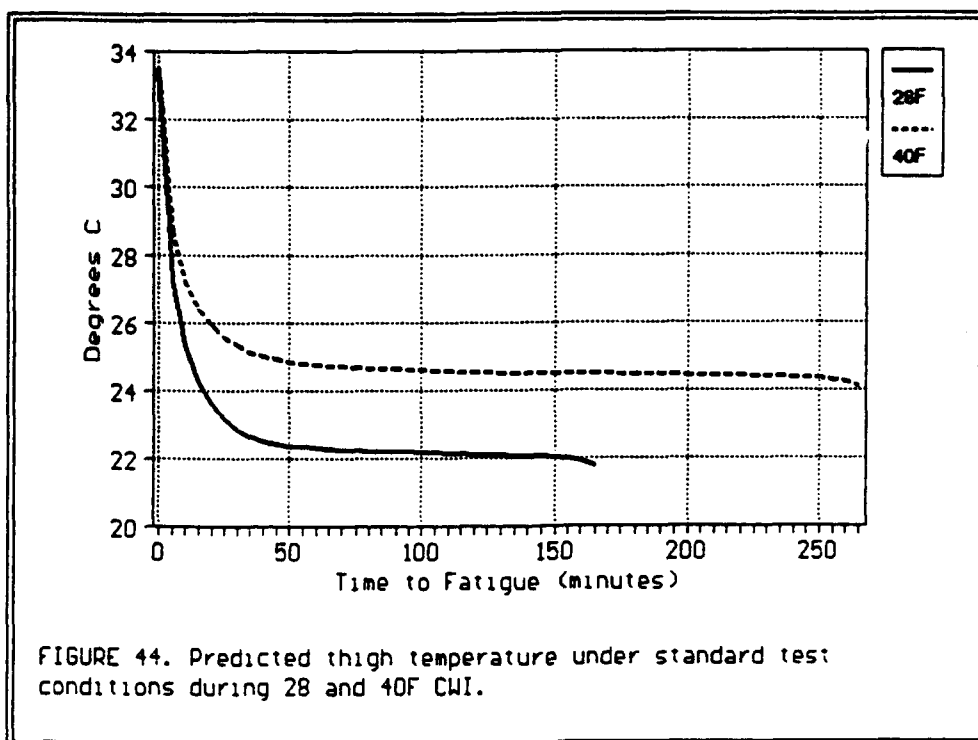
5. Changing the exercise metabolic distribution had no effect, as expected, while in a relaxed sitting posture. In this one case, we varied two parameters together to determine the effects of EMD by running the four distributions with an EMR of 50 BTU/hr. It was found that as the arms performed more of the simulated work relative to the legs, fatigue occurred more quickly, T_{re} dropped and reached critical levels faster. Model output predictions were roughly equal for the case of primarily upper body exercise versus primarily leg exercise.

6. The relative insensitivity to increasing wind speed was expected under conditions of head-out CWI. This was due to the much greater thermal conductivity of water as compared to air. In effect, the ability of the water to extract heat from the subject eliminated any effects of high wind speed.









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NAWCADWAR-93069-60

APPENDIX A

**MODEL VALIDATION PREDICTIONS BASED
ON FINNISH IMMERSION DATA³⁻⁶**

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 1			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 1						
SUIT: FITZ WRIGHT			WATER TEMP: 31.46 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	34.20	30.80	30.80	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	33.50	29.30	29.80	-0.70	-1.50	-1.00	32.62	26.27	31.13	-2.13	-6.43	-4.64
30	33.00	26.40	29.50	-1.20	-4.40	-1.30	31.10	23.29	29.21	-3.65	-9.41	-6.56
45	32.20	24.20	28.50	-2.00	-6.60	-2.30	30.51	20.84	27.78	-4.24	-11.86	-7.99
60	31.60	22.80	27.00	-2.60	-8.00	-3.80	30.28	18.77	26.58	-4.47	-13.93	-9.19
75	31.10	21.40	26.20	-3.10	-9.40	-4.60	30.16	17.01	25.53	-4.59	-15.69	-10.24
90	31.10	21.60	24.30	-3.10	-9.20	-6.50	30.11	15.51	24.61	-4.64	-17.19	-11.16
105	30.60	20.60	22.40	-3.60	-10.20	-8.40	30.12	14.26	23.81	-4.63	-18.44	-11.96
120	30.80	21.20	20.90	-3.40	-9.60	-9.90	30.15	13.21	23.11	-4.60	-19.49	-12.66
135	30.80	19.50	19.00	-3.40	-11.30	-11.80	30.19	12.34	22.49	-4.56	-20.36	-13.28
150	30.90	19.50	17.50	-3.30	-11.30	-13.30	30.23	11.62	21.95	-4.52	-21.08	-13.82
165	30.60	18.50	17.00	-3.60	-12.30	-13.80	30.27	11.02	21.48	-4.48	-21.68	-14.29
180	31.00	18.00	16.00	-3.20	-12.80	-14.80	30.30	10.53	21.07	-4.45	-22.17	-14.70
195	30.60	16.00	16.00	-3.60	-14.80	-14.80	30.32	10.11	20.70	-4.43	-22.59	-15.07
210	31.10	16.50	15.50	-3.10	-14.30	-15.30	30.34	9.77	20.38	-4.41	-22.93	-15.39
225	30.70	15.00	16.50	-3.50	-15.80	-14.30	30.36	9.49	20.10	-4.39	-23.21	-15.67
240	31.10	16.50	16.50	-3.10	-14.30	-14.30	30.37	9.26	19.86	-4.38	-23.44	-15.91
255	31.10	14.80	17.00	-3.10	-16.00	-13.80	30.38	9.06	19.64	-4.37	-23.64	-16.13
270	30.90	16.00	16.00	-3.30	-14.80	-14.80	30.39	8.90	19.45	-4.36	-23.80	-16.32
285	30.80	14.00	15.50	-3.40	-16.80	-15.30	30.40	8.77	19.28	-4.35	-23.93	-16.49
300	31.00	15.00	15.50	-3.20	-15.80	-15.30	30.41	8.65	19.13	-4.34	-24.05	-16.64
315	31.20	13.00	15.50	-3.00	-17.80	-15.30	30.41	8.56	19.00	-4.34	-24.14	-16.77
330	31.80	13.00	15.00	-2.40	-17.80	-15.80	30.41	8.49	18.88	-4.34	-24.21	-16.89
345	32.20	11.50	14.50	-2.00	-19.30	-16.30	30.42	8.42	18.78	-4.33	-24.28	-16.99
360	32.50	12.50	14.50	-1.70	-18.30	-16.30	30.42	8.37	18.68	-4.33	-24.33	-17.09

TABLE A1. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6m: male subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 3 SEX: Male							MODEL PREDICTIONS for SUBJECT No.: 3						
SUIT: BAYLEY WATER TEMP: 31.46 deg F													
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)			
0	31.10	28.10	31.10	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00	
15	30.10	26.30	31.00	-1.00	-1.80	-0.10	32.61	26.25	31.12	-2.14	-6.45	-4.65	
30	30.20	24.80	30.70	-0.90	-3.30	-0.40	31.07	23.22	29.20	-3.68	-9.48	-6.57	
45	29.20	23.20	30.30	-1.90	-4.90	-0.80	30.47	20.76	27.78	-4.28	-11.94	-7.99	
60	28.70	23.00	29.70	-2.40	-5.10	-1.40	30.22	18.67	26.57	-4.53	-14.03	-9.20	
75	28.90	21.70	28.40	-2.20	-6.40	-2.70	30.09	16.90	25.52	-4.66	-15.80	-10.25	
90	28.40	20.20	27.60	-2.70	-7.90	-3.50	30.04	15.41	24.62	-4.71	-17.29	-11.15	
105	28.80	19.00	26.80	-2.30	-9.10	-4.30	30.05	14.13	23.83	-4.70	-18.57	-11.94	
120	29.20	18.50	26.60	-1.90	-9.60	-4.50	30.08	13.09	23.15	-4.67	-19.61	-12.62	
135	29.20	16.50	24.70	-1.90	-11.60	-6.40	30.13	12.22	22.55	-4.62	-20.48	-13.22	
150	29.30	16.50	23.70	-1.80	-11.60	-7.40	30.17	11.49	22.02	-4.58	-21.21	-13.75	
165	29.30	15.00	22.70	-1.80	-13.10	-8.40	30.20	10.90	21.57	-4.55	-21.80	-14.20	
180	29.40	13.50	21.00	-1.70	-14.60	-10.10	30.24	10.41	21.17	-4.51	-22.29	-14.60	
195	29.30	12.50	20.10	-1.80	-15.60	-11.00	30.26	10.01	20.82	-4.49	-22.69	-14.95	
210	29.40	12.50	19.50	-1.70	-15.60	-11.60	30.28	9.67	20.51	-4.47	-23.03	-15.26	
225	29.60	13.00	19.00	-1.50	-15.10	-12.10	30.30	9.40	20.24	-4.45	-23.30	-15.53	
240	29.40	13.00	19.50	-1.70	-15.10	-11.60	30.31	9.17	20.01	-4.44	-23.53	-15.76	
255	29.20	13.20	21.40	-1.90	-14.90	-9.70	30.33	8.98	19.80	-4.42	-23.72	-15.97	
270	29.20	13.00	21.20	-1.90	-15.10	-9.90	30.33	8.83	19.62	-4.42	-23.87	-16.15	
285	28.80	12.50	20.90	-2.30	-15.60	-10.20	30.34	8.70	19.46	-4.41	-24.00	-16.31	
300	29.10	13.00	19.50	-2.00	-15.10	-11.60	30.35	8.59	19.32	-4.40	-24.11	-16.45	
315	29.10	13.00	19.00	-2.00	-15.10	-12.10	30.35	8.51	19.19	-4.40	-24.19	-16.58	
330	29.10	12.50	18.00	-2.00	-15.60	-13.10	30.36	8.43	19.08	-4.39	-24.27	-16.69	
345	29.10	12.50	17.00	-2.00	-15.60	-14.10	30.36	8.38	18.99	-4.39	-24.32	-16.78	
360	29.30	12.50	17.50	-1.80	-15.60	-13.60	30.36	8.33	18.90	-4.39	-24.37	-16.87	

TABLE A2. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6m: male subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 6				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 6					
SUIT: NORD 15		WATER TEMP: 31.46 deg F										
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		

0	31.50	30.40	27.80	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	31.10	27.80	25.10	-0.40	-2.60	-2.70	32.70	26.27	31.15	-2.05	-6.43	-4.62
30	31.00	25.30	25.80	-0.50	-5.10	-2.00	31.20	23.22	29.21	-3.55	-9.48	-6.56
45	31.60	22.40	24.40	0.10	-8.00	-3.40	30.62	20.75	27.79	-4.13	-11.95	-7.98
60	31.90	20.40	23.40	0.40	-10.00	-4.40	30.41	18.65	26.58	-4.34	-14.05	-9.19
75	31.50	19.00	22.70	0.00	-11.40	-5.10	30.32	16.87	25.53	-4.43	-15.83	-10.24
90	31.10	18.00	20.90	-0.40	-12.40	-6.90	30.30	15.37	24.63	-4.45	-17.33	-11.14
105	31.10	17.00	18.00	-0.40	-13.40	-9.80	30.32	14.09	23.84	-4.43	-18.61	-11.93
120	31.00	17.00	17.50	-0.50	-13.40	-10.30	30.37	13.04	23.16	-4.38	-19.66	-12.61
135	30.80	16.00	15.00	-0.70	-14.40	-12.80	30.42	12.17	22.56	-4.33	-20.53	-13.21
150	30.50	17.00	14.50	-1.00	-13.40	-13.30	30.46	11.45	22.04	-4.29	-21.25	-13.73
165	30.20	16.00	13.50	-1.30	-14.40	-14.30	30.50	10.86	21.58	-4.25	-21.84	-14.19
180	30.00	16.00	13.50	-1.50	-14.40	-14.30	30.53	10.36	21.19	-4.22	-22.34	-14.58
195	30.10	17.00	12.50	-1.40	-13.40	-15.30	30.56	9.96	20.84	-4.19	-22.74	-14.93
210	30.50	15.00	12.00	-1.00	-15.40	-15.80	30.58	9.63	20.54	-4.17	-23.07	-15.23
225	29.90	15.00	12.00	-1.60	-15.40	-15.80	30.59	9.35	20.27	-4.16	-23.35	-15.50
240	30.10	15.50	12.00	-1.40	-14.90	-15.80	30.61	9.13	20.04	-4.14	-23.57	-15.73
255	30.20	14.70	11.30	-1.30	-15.70	-16.50	30.62	8.94	19.84	-4.13	-23.76	-15.93
270	30.10	14.20	11.30	-1.40	-16.20	-16.50	30.63	8.79	19.66	-4.12	-23.91	-16.11
285	30.50	13.50	11.50	-1.00	-16.90	-16.30	30.64	8.66	19.50	-4.11	-24.04	-16.27
300	31.00	12.50	11.50	-0.50	-17.90	-16.30	30.64	8.56	19.36	-4.11	-24.14	-16.41
315	30.30	12.50	11.50	-1.20	-17.90	-16.30	30.65	8.47	19.24	-4.10	-24.23	-16.53
330	31.00	12.00	11.00	-0.50	-18.40	-16.80	30.65	8.40	19.13	-4.10	-24.30	-16.64
345	30.40	11.00	10.00	-1.10	-19.40	-17.80	30.65	8.34	19.04	-4.10	-24.36	-16.73
360	30.40	11.50	10.00	-1.10	-18.90	-17.80	30.65	8.29	18.96	-4.10	-24.41	-16.81

TABLE A3. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6m: male subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 8			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 8						
SUIT: IMPERIAL			WATER TEMP: 31.28 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	31.60	30.20	29.20	0.00	0.00	0.00	34.75	32.69	35.76	0.00	0.00	0.00
15	30.90	28.60	28.00	-0.70	-1.60	-1.20	32.04	26.22	31.10	-2.71	-6.47	-4.66
30	30.50	26.20	26.50	-1.10	-4.00	-2.70	30.37	23.24	29.21	-4.38	-9.45	-6.55
45	29.90	22.70	25.20	-1.70	-7.50	-4.00	29.54	20.82	27.78	-5.21	-11.87	-7.98
60	29.90	21.00	24.10	-1.70	-9.20	-5.10	29.05	18.75	26.57	-5.70	-13.94	-9.19
75	29.40	17.50	23.50	-2.20	-12.70	-5.70	28.74	16.99	25.54	-6.01	-15.70	-10.22
90	28.00	17.50	22.80	-3.60	-12.70	-6.40	28.55	15.51	24.64	-6.20	-17.18	-11.12
105	28.20	15.00	21.80	-3.40	-15.20	-7.40	28.44	14.26	23.85	-6.31	-18.43	-11.91
120	29.30	13.60	21.00	-2.30	-16.60	-8.20	28.39	13.23	23.16	-6.36	-19.46	-12.60
135	29.50	12.40	20.20	-2.10	-17.80	-9.00	28.37	12.37	22.55	-6.38	-20.32	-13.21
150	28.30	12.00	19.00	-3.30	-18.20	-10.20	28.37	11.65	22.02	-6.38	-21.04	-13.74
165	26.10	12.50	19.00	-5.50	-17.70	-10.20	28.38	11.06	21.55	-6.37	-21.63	-14.21
180	28.60	12.00	17.00	-3.00	-18.20	-12.20	28.39	10.57	21.13	-6.36	-22.12	-14.63
195	28.00	12.00	17.50	-3.60	-18.20	-11.70	28.41	10.16	20.77	-6.34	-22.53	-14.99
210	27.50	12.50	17.50	-4.10	-17.70	-11.70	28.42	9.82	20.45	-6.33	-22.87	-15.31
225	27.60	12.50	17.00	-4.00	-17.70	-12.20	28.44	9.54	20.16	-6.31	-23.15	-15.60
240	27.80	12.50	17.50	-3.80	-17.70	-11.70	28.45	9.31	19.91	-6.30	-23.38	-15.85
255	27.80	12.50	18.00	-3.80	-17.70	-11.20	28.47	9.11	19.68	-6.28	-23.58	-16.08
270	28.20	12.50	19.00	-3.40	-17.70	-10.20	28.48	8.96	19.49	-6.27	-23.73	-16.27
285	27.90	12.50	19.00	-3.70	-17.70	-10.20	28.48	8.82	19.31	-6.27	-23.87	-16.45
300	27.80	12.00	18.50	-3.80	-18.20	-10.70	28.49	8.71	19.15	-6.26	-23.98	-16.61
315	28.30	12.10	18.50	-3.30	-18.10	-10.70	28.50	8.62	19.02	-6.25	-24.07	-16.74
330	28.70	12.00	18.00	-2.90	-18.20	-11.20	28.50	8.54	18.89	-6.25	-24.15	-16.87
345	28.70	12.00	17.50	-2.90	-18.20	-11.70	28.51	8.48	18.78	-6.24	-24.21	-16.98
360	28.70	12.50	17.00	-2.90	-17.70	-12.20	28.51	8.43	18.69	-6.24	-24.26	-17.07

TABLE A4. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6m: male subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 13			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 13						
SUIT: BAYLEY			WATER TEMP: 31.01 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.80	29.20	28.80	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	32.50	27.50	28.30	-0.30	-1.70	-0.50	32.04	26.22	31.08	-2.71	-6.48	-4.69
30	32.40	26.20	27.90	-0.40	-3.00	-0.90	30.49	23.26	29.17	-4.26	-9.44	-6.60
45	32.30	23.20	26.60	-0.50	-6.00	-2.20	29.78	20.86	27.74	-4.97	-11.84	-8.03
60	32.40	22.50	25.80	-0.40	-6.70	-3.00	29.37	18.80	26.53	-5.38	-13.90	-9.24
75	32.40	21.40	24.00	-0.40	-7.80	-4.80	29.13	17.04	25.48	-5.62	-15.66	-10.29
90	32.30	20.90	24.30	-0.50	-8.30	-4.50	28.99	15.56	24.56	-5.76	-17.14	-11.21
105	32.30	19.20	23.50	-0.50	-10.00	-5.30	28.92	14.31	23.75	-5.83	-18.39	-12.02
120	32.50	18.50	23.40	-0.30	-10.70	-5.40	28.89	13.28	23.04	-5.86	-19.42	-12.73
135	32.50	17.40	24.50	-0.30	-11.80	-4.30	28.89	12.41	22.41	-5.86	-20.29	-13.36
150	32.50	15.70	24.50	-0.30	-13.50	-4.30	28.91	11.68	21.86	-5.84	-21.02	-13.91
165	32.50	15.10	26.50	-0.30	-14.10	-2.30	28.93	11.08	21.37	-5.82	-21.62	-14.40
180	31.50	15.00	27.10	-1.30	-14.20	-1.70	28.95	10.57	20.94	-5.80	-22.13	-14.83
195	30.70	14.50	27.20	-2.10	-14.70	-1.60	28.97	10.15	20.56	-5.78	-22.55	-15.21
210	30.30	14.00	25.80	-2.50	-15.20	-3.00	28.99	9.80	20.22	-5.76	-22.90	-15.55
225	30.30	13.90	24.90	-2.50	-15.30	-3.90	29.00	9.51	19.92	-5.75	-23.19	-15.85
240	30.90	14.50	25.30	-1.90	-14.70	-3.50	29.01	9.26	19.66	-5.74	-23.44	-16.11
255	30.90	14.00	26.10	-1.90	-15.20	-2.70	29.03	9.06	19.42	-5.72	-23.64	-16.35
270	30.80	13.50	25.30	-2.00	-15.70	-3.50	29.03	8.89	19.22	-5.72	-23.81	-16.55
285	30.90	12.90	24.50	-1.90	-16.30	-4.30	29.04	8.74	19.03	-5.71	-23.96	-16.74
300	31.10	12.50	23.90	-1.70	-16.70	-4.90	29.05	8.62	18.87	-5.70	-24.08	-16.90
315	31.50	12.90	22.70	-1.30	-16.30	-6.10	29.05	8.53	18.72	-5.70	-24.17	-17.05
330	32.10	12.40	21.90	-0.70	-16.80	-6.90	29.06	8.44	18.59	-5.69	-24.26	-17.18
345	32.00	12.00	21.60	-0.80	-17.20	-7.20	29.06	8.37	18.48	-5.69	-24.33	-17.29
360	31.70	12.00	21.10	-1.10	-17.20	-7.70	29.06	8.32	18.38	-5.69	-24.38	-17.39

TABLE A5. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6m: male subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 2			SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 2						
SUIT:	NELLY HANSON		WATER TEMP:		31.64 deg F							
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	30.10	29.40	27.90	0.00	0.00	0.00	34.75	32.69	35.77	0.00	0.00	0.00
15	29.30	28.30	26.70	-0.80	-1.10	-1.20	31.93	26.16	31.01	-2.82	-6.53	-4.76
30	28.90	27.50	24.50	-1.20	-1.90	-3.40	30.17	23.25	29.14	-4.58	-9.44	-6.63
45	27.70	26.10	23.90	-2.40	-3.30	-4.00	29.17	20.90	27.75	-5.58	-11.79	-8.02
60	27.40	25.10	23.60	-2.70	-4.30	-4.30	28.53	18.90	26.58	-6.22	-13.79	-9.19
75	26.50	24.20	24.40	-3.60	-5.20	-3.50	28.11	17.19	25.58	-6.64	-15.50	-10.19
90	27.00	25.10	23.50	-3.10	-4.30	-4.40	27.82	15.74	24.71	-6.93	-16.95	-11.06
105	26.40	23.40	22.30	-3.70	-6.00	-5.60	27.61	14.52	23.93	-7.14	-18.17	-11.84
120	26.20	23.40	21.20	-3.90	-6.00	-6.70	27.46	13.51	23.26	-7.29	-19.18	-12.51
135	25.80	22.40	20.30	-4.30	-7.00	-7.60	27.36	12.66	22.65	-7.39	-20.03	-13.12
150	26.40	21.40	19.50	-3.70	-8.00	-8.40	27.29	11.94	22.12	-7.46	-20.75	-13.65
165	26.40	20.50	18.50	-3.70	-8.90	-9.40	27.25	11.36	21.65	-7.50	-21.33	-14.12
180	26.70	21.00	18.00	-3.40	-8.40	-9.90	27.23	10.86	21.23	-7.52	-21.83	-14.54
195	26.60	20.30	18.00	-3.50	-9.10	-9.90	27.22	10.46	20.87	-7.53	-22.23	-14.90
210	26.60	19.50	17.50	-3.50	-9.90	-10.40	27.21	10.11	20.54	-7.54	-22.58	-15.23
225	26.30	18.00	17.50	-3.80	-11.40	-10.40	27.22	9.83	20.25	-7.53	-22.86	-15.52
240	26.40	18.00	17.50	-3.70	-11.40	-10.40	27.22	9.59	19.99	-7.53	-23.10	-15.78
255	26.50	17.50	17.50	-3.60	-11.90	-10.40	27.23	9.39	19.76	-7.52	-23.30	-16.01
270	26.80	17.70	16.90	-3.30	-11.70	-11.00	27.23	9.23	19.56	-7.52	-23.46	-16.21
285	27.50	17.50	16.50	-2.60	-11.90	-11.40	27.24	9.09	19.38	-7.51	-23.60	-16.39
300	28.10	17.00	16.50	-2.00	-12.40	-11.40	27.25	8.98	19.22	-7.50	-23.71	-16.55
315	28.60	16.50	15.50	-1.50	-12.90	-12.40	27.25	8.89	19.07	-7.50	-23.80	-16.70
330	29.10	16.50	15.50	-1.00	-12.90	-12.40	27.26	8.81	18.94	-7.49	-23.88	-16.83
345	29.20	16.00	14.50	-0.90	-13.40	-13.40	27.26	8.74	18.83	-7.49	-23.95	-16.94
360	25.60	16.00	14.00	-4.50	-13.40	-13.90	27.27	8.69	18.73	-7.48	-24.00	-17.04

TABLE A6. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6f: female subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 5				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 5					
SUIT: BAYLEY				WATER TEMP: 31.28 deg F								
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.80	26.30	30.50	0.00	0.00	0.00	34.75	32.69	35.76	0.00	0.00	0.00
15	32.00	24.40	29.10	-0.80	-1.90	-1.40	31.79	26.00	30.84	-2.96	-6.69	-4.92
30	31.70	23.10	28.20	-1.10	-3.20	-2.30	30.00	23.16	28.97	-4.75	-9.53	-6.79
45	31.60	23.40	30.10	-1.20	-2.90	-0.40	28.92	20.87	27.59	-5.83	-11.82	-8.17
60	31.20	21.20	31.10	-1.60	-5.10	0.60	28.20	18.91	26.44	-6.55	-13.78	-9.32
75	30.80	16.00	27.30	-2.00	-10.30	-3.20	27.70	17.22	25.45	-7.05	-15.47	-10.31
90	30.20	15.00	30.20	-2.60	-11.30	-0.30	27.34	15.80	24.59	-7.41	-16.89	-11.17
105	30.40	14.50	26.40	-2.40	-11.80	-4.10	27.08	14.60	23.83	-7.67	-18.09	-11.93
120	29.60	13.00	25.60	-3.20	-13.30	-4.90	26.89	13.59	23.16	-7.86	-19.10	-12.60
135	29.20	12.50	24.00	-3.60	-13.80	-6.50	26.74	12.74	22.56	-8.01	-19.95	-13.20
150	29.20	11.80	23.60	-3.60	-14.50	-6.90	26.63	12.03	22.02	-8.12	-20.66	-13.74
165	29.10	11.50	22.00	-3.70	-14.80	-8.50	26.54	11.44	21.54	-8.21	-21.25	-14.22
180	29.00	11.00	21.20	-3.80	-15.30	-9.30	26.48	10.93	21.10	-8.27	-21.76	-14.66
195	29.40	11.00	19.00	-3.40	-15.30	-11.50	26.43	10.52	20.72	-8.32	-22.17	-15.04
210	29.50	10.50	17.00	-3.30	-15.80	-13.50	26.39	10.16	20.38	-8.36	-22.53	-15.38
225	29.30	10.00	17.00	-3.50	-16.30	-13.50	26.37	9.86	20.07	-8.38	-22.83	-15.69
240	29.20	10.50	16.00	-3.60	-15.80	-14.50	26.36	9.61	19.80	-8.39	-23.08	-15.96
255	28.90	10.50	15.00	-3.90	-15.80	-15.50	26.35	9.40	19.56	-8.40	-23.29	-16.20
270	28.30	10.50	14.50	-4.50	-15.80	-16.00	26.34	9.23	19.35	-8.41	-23.46	-16.41
285	27.90	10.50	14.50	-4.90	-15.80	-16.00	26.34	9.08	19.15	-8.41	-23.61	-16.61
300	27.90	10.50	14.50	-4.90	-15.80	-16.00	26.34	8.95	18.98	-8.41	-23.74	-16.78
315	28.00	10.50	14.50	-4.80	-15.80	-16.00	26.34	8.85	18.83	-8.41	-23.84	-16.93
330	27.90	10.00	14.50	-4.90	-16.30	-16.00	26.35	8.76	18.69	-8.40	-23.93	-17.07
345	28.20	10.00	14.00	-4.60	-16.30	-16.50	26.35	8.69	18.57	-8.40	-24.00	-17.19
360	29.00	10.50	13.50	-3.80	-15.80	-17.00	26.35	8.63	18.46	-8.40	-24.06	-17.30

TABLE A7. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6f: female subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 7				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 7					
SUIT: NORD 15				WATER TEMP: 31.64 deg F								
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	33.20	30.40	28.80	0.00	0.00	0.00	34.75	32.69	35.76	0.00	0.00	0.00
15	33.20	29.40	28.30	0.00	-1.00	-0.50	31.97	26.14	30.99	-2.78	-6.55	-4.77
30	33.50	26.10	27.10	0.30	-4.30	-1.70	30.18	23.22	29.13	-4.57	-9.47	-6.63
45	33.10	23.50	26.50	-0.10	-6.90	-2.30	29.17	20.87	27.74	-5.58	-11.82	-8.02
60	33.80	21.40	26.20	0.60	-9.00	-2.60	28.53	18.86	26.58	-6.22	-13.83	-9.18
75	33.20	19.00	25.30	0.00	-11.40	-3.50	28.10	17.15	25.58	-6.65	-15.54	-10.18
90	33.10	16.50	24.30	-0.10	-13.90	-4.50	27.82	15.71	24.72	-6.93	-16.98	-11.04
105	32.30	14.50	23.10	-0.90	-15.90	-5.70	27.61	14.48	23.95	-7.14	-18.21	-11.81
120	32.60	13.50	21.70	-0.60	-16.90	-7.10	27.46	13.47	23.28	-7.29	-19.22	-12.48
135	31.40	13.00	20.60	-1.80	-17.40	-8.20	27.36	12.61	22.68	-7.39	-20.08	-13.08
150	31.60	13.50	19.50	-1.60	-16.90	-9.30	27.28	11.90	22.15	-7.47	-20.79	-13.61
165	31.10	12.50	19.00	-2.10	-17.90	-9.80	27.24	11.32	21.69	-7.51	-21.37	-14.07
180	31.40	12.50	17.50	-1.80	-17.90	-11.30	27.21	10.83	21.28	-7.54	-21.86	-14.48
195	31.00	12.50	16.50	-2.20	-17.90	-12.30	27.19	10.42	20.91	-7.56	-22.27	-14.85
210	30.90	12.50	16.50	-2.30	-17.90	-12.30	27.19	10.08	20.59	-7.56	-22.61	-15.17
225	30.60	13.00	16.00	-2.60	-17.40	-12.80	27.19	9.79	20.30	-7.56	-22.90	-15.46
240	30.80	12.50	15.50	-2.40	-17.90	-13.30	27.19	9.56	20.05	-7.56	-23.13	-15.71
255	31.60	12.50	15.00	-1.60	-17.90	-13.80	27.20	9.36	19.82	-7.55	-23.33	-15.94
270	31.90	11.50	14.30	-1.30	-18.90	-14.50	27.20	9.32	19.62	-7.55	-23.37	-16.14
285	32.00	12.50	15.00	-1.20	-17.90	-13.80	27.21	9.07	19.44	-7.54	-23.62	-16.32
300	31.90	11.50	14.00	-1.30	-18.90	-14.80	27.22	8.95	19.29	-7.53	-23.74	-16.47
315	31.70	12.50	14.50	-1.50	-17.90	-14.30	27.22	8.86	19.14	-7.53	-23.83	-16.62
330	31.80	11.50	14.00	-1.40	-18.90	-14.80	27.23	8.78	19.02	-7.52	-23.91	-16.74
345	31.90	13.00	15.00	-1.30	-17.40	-13.80	27.23	8.72	18.91	-7.52	-23.97	-16.85
360	32.40	12.50	14.50	-0.80	-17.90	-14.30	27.24	8.66	18.81	-7.51	-24.03	-16.95

TABLE A8. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6f: female subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 17			SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 17						
SUIT: NELLY HANSON			WATER TEMP: 31.28 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0.00	30.40	27.10	26.40	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15.00	29.80	26.60	25.80	-0.60	-0.50	-0.60	32.47	26.24	31.10	-2.28	-6.46	-4.67
30.00	29.10	24.10	24.10	-1.30	-3.00	-2.30	30.84	23.23	29.18	-3.91	-9.47	-6.59
45.00	28.60	28.90	22.00	-1.80	1.80	-4.40	30.18	20.80	27.76	-4.57	-11.90	-8.01
60.00	27.50	27.60	27.60	-2.90	0.50	1.20	29.84	18.73	26.55	-4.91	-13.97	-9.22
75.00	27.00	18.00	23.20	-3.40	-9.10	-3.20	29.65	16.96	25.50	-5.10	-15.74	-10.27
90.00	26.10	16.50	26.10	-4.30	-10.60	-0.30	29.56	15.47	24.59	-5.19	-17.23	-11.18
105.00	25.70	16.50	23.60	-4.70	-10.60	-2.80	29.54	14.21	23.79	-5.21	-18.49	-11.98
120.00	25.20	15.00	24.10	-5.20	-12.10	-2.30	29.55	13.17	23.10	-5.20	-19.53	-12.67
135.00	25.10	15.00	23.00	-5.30	-12.10	-3.40	29.58	12.30	22.49	-5.17	-20.40	-13.28
150.00	24.70	14.60	21.90	-5.70	-12.50	-4.50	29.62	11.58	21.95	-5.13	-21.12	-13.82
165.00	24.90	15.20	22.70	-5.50	-11.90	-3.70	29.65	10.99	21.48	-5.10	-21.71	-14.29
180.00	24.50	15.00	22.00	-5.90	-12.10	-4.40	29.68	10.49	21.07	-5.07	-22.21	-14.70
195.00	23.70	15.00	21.30	-6.70	-12.10	-5.10	29.71	10.08	20.70	-5.04	-22.62	-15.07
210.00	22.40	14.50	20.20	-8.00	-12.60	-6.20	29.73	9.74	20.38	-5.02	-22.96	-15.39
225.00	22.50	15.00	19.50	-7.90	-12.10	-6.90	29.75	9.46	20.10	-5.00	-23.24	-15.67
240.00	21.80	15.00	21.40	-8.60	-12.10	-5.00	29.77	9.23	19.85	-4.98	-23.47	-15.92
255.00	21.50	15.50	21.40	-8.90	-11.60	-5.00	29.78	9.03	19.63	-4.97	-23.67	-16.14
270.00	21.00	15.00	21.50	-9.40	-12.10	-4.90	29.79	8.87	19.44	-4.96	-23.83	-16.33
285.00	20.80	15.00	21.00	-9.60	-12.10	-5.40	29.80	8.75	19.26	-4.95	-23.95	-16.51
300.00	20.60	14.50	21.40	-9.80	-12.60	-5.00	29.81	8.63	19.11	-4.94	-24.07	-16.66
315.00	20.30	15.00	20.80	-10.10	-12.10	-5.60	29.81	8.54	18.98	-4.94	-24.16	-16.79
330.00	20.10	14.50	19.00	-10.30	-12.60	-7.40	29.82	8.46	18.86	-4.93	-24.24	-16.91
345.00	19.50	14.50	19.00	-10.90	-12.60	-7.40	29.82	8.40	18.75	-4.93	-24.30	-17.02
360.00	20.00	14.50	19.00	-10.40	-12.60	-7.40	29.82	8.35	18.66	-4.93	-24.35	-17.11

TABLE A9. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6f: female subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 19			SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 19						
SUIT: URSUIT			WATER TEMP: 31.64 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.70	28.20	29.20	0.00	0.00	0.00	34.75	32.69	35.76	0.00	0.00	0.00
15	31.80	26.40	28.80	-0.90	-1.80	-0.40	32.92	26.25	31.15	-1.83	-6.44	-4.61
30	31.20	24.70	27.40	-1.50	-3.50	-1.80	31.16	23.12	29.22	-3.59	-9.57	-6.54
45	30.80	23.30	26.10	-1.90	-4.90	-3.10	30.51	20.61	27.81	-4.24	-12.08	-7.95
60	30.70	19.50	25.10	-2.00	-8.70	-4.10	30.22	18.51	26.61	-4.53	-14.18	-9.15
75	30.60	18.00	23.20	-2.10	-10.20	-6.00	30.09	16.74	25.59	-4.66	-15.95	-10.17
90	30.00	16.10	21.80	-2.70	-12.10	-7.40	30.06	15.27	24.73	-4.69	-17.42	-11.03
105	29.30	15.00	21.30	-3.40	-13.20	-7.90	30.07	14.00	23.97	-4.68	-18.69	-11.79
120	29.20	15.00	19.00	-3.50	-13.20	-10.20	30.11	12.94	23.33	-4.64	-19.75	-12.43
135	28.90	15.00	18.00	-3.80	-13.20	-11.20	30.16	12.06	22.76	-4.59	-20.63	-13.00
150	29.00	14.50	18.50	-3.70	-13.70	-10.70	30.20	11.33	22.28	-4.55	-21.36	-13.48
165	28.70	13.50	17.50	-4.00	-14.70	-11.70	30.24	10.74	21.86	-4.51	-21.95	-13.90
180	28.60	13.00	17.50	-4.10	-15.20	-11.70	30.28	10.26	21.49	-4.47	-22.43	-14.27
195	28.40	12.00	18.00	-4.30	-16.20	-11.20	30.30	9.87	21.17	-4.45	-22.82	-14.59
210	28.80	12.50	16.00	-3.90	-15.70	-13.20	30.33	9.54	20.89	-4.42	-23.15	-14.87
225	28.60	13.00	16.00	-4.10	-15.20	-13.20	30.34	9.28	20.65	-4.41	-23.41	-15.11
240	28.70	12.50	15.00	-4.00	-15.70	-14.20	30.36	9.08	20.44	-4.39	-23.61	-15.32
255	29.70	12.50	14.50	-3.00	-15.70	-14.70	30.37	8.89	20.25	-4.38	-23.80	-15.51
270	30.30	11.70	14.50	-2.40	-16.50	-14.70	30.38	8.75	20.09	-4.37	-23.94	-15.67
285	30.60	12.00	13.00	-2.10	-16.20	-16.20	30.39	8.63	19.95	-4.36	-24.06	-15.81
300	31.00	11.50	12.50	-1.70	-16.70	-16.70	30.40	8.53	19.82	-4.35	-24.16	-15.94
315	30.90	11.50	12.50	-1.80	-16.70	-16.70	30.40	8.45	19.71	-4.35	-24.24	-16.05
330	31.70	12.00	11.60	-1.00	-16.20	-17.60	30.41	8.39	19.62	-4.34	-24.30	-16.14
345	31.60	11.50	11.50	-1.10	-16.70	-17.70	30.41	8.34	19.53	-4.34	-24.35	-16.23
360	32.40	12.50	11.50	-0.30	-15.70	-17.70	30.41	8.29	19.46	-4.34	-24.40	-16.30

TABLE A10. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-6f: female subjects completing entire 360 minute immersion.

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HUMAN SUBJECT No.: 4			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 4						
SUIT: LIUKKO			WATER TEMP: 31.55 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	33.20	33.80	28.60	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	33.10	29.00	25.50	-0.10	-4.80	-3.10	32.28	26.28	31.12	-2.47	-6.42	-4.65
30	32.70	26.60	22.40	-0.50	-7.20	-6.20	30.71	23.34	29.21	-4.04	-9.36	-6.56
45	31.20	25.10	20.50	-2.00	-8.70	-8.10	30.05	20.95	27.80	-4.70	-11.75	-7.97
60	30.40	24.40	19.00	-2.80	-9.40	-9.60	29.69	18.90	26.59	-5.06	-13.80	-9.18
75	30.10	24.20	17.50	-3.10	-9.60	-11.10	29.49	17.15	25.55	-5.26	-15.55	-10.22
90	30.30	24.00	16.50	-2.90	-9.80	-12.10	29.38	15.68	24.64	-5.37	-17.02	-11.13
105	30.40	24.00	16.00	-2.80	-9.80	-12.60	29.33	14.44	23.84	-5.42	-18.26	-11.93
120	30.30	24.00	15.00	-2.90	-9.80	-13.60	29.33	13.41	23.13	-5.42	-19.29	-12.64
135	30.40	24.20	14.00	-2.80	-9.60	-14.60	29.34	12.55	22.51	-5.41	-20.15	-13.26
150	31.00	24.60	13.00	-2.20	-9.20	-15.60	29.37	11.82	21.96	-5.38	-20.88	-13.81
165	30.70	24.60	12.50	-2.50	-9.20	-16.10	29.39	11.23	21.48	-5.36	-21.47	-14.29
180	30.40	25.40	12.00	-2.80	-8.40	-16.60	29.42	10.73	21.06	-5.33	-21.97	-14.71
195	31.20	24.20	11.50	-2.00	-9.60	-17.10	29.44	10.31	20.68	-5.31	-22.39	-15.09
210	30.60	23.80	11.50	-2.60	-10.00	-17.10	29.46	9.96	20.35	-5.29	-22.74	-15.42
225	31.30	23.70	11.00	-1.90	-10.10	-17.60	29.47	9.67	20.06	-5.28	-23.03	-15.71
240	31.50	23.60	10.50	-1.70	-10.20	-18.10	29.49	9.43	19.80	-5.26	-23.27	-15.97
255	31.60	23.60	10.50	-1.60	-10.20	-18.10	29.50	9.23	19.57	-5.25	-23.47	-16.20

TABLE A11. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-5: subjects completing 4 to 5 hours immersion.

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HUMAN SUBJECT No.:			10	SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 10						
SUIT:	IMPERIAL		WATER TEMP:		31.55 deg F								
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)			
0	32.70	26.90	28.30	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00	
15	31.60	26.30	26.80	-1.10	-0.60	-1.50	32.69	26.30	31.16	-2.06	-6.40	-4.61	
30	30.60	25.30	25.10	-2.10	-1.60	-3.20	31.20	23.28	29.23	-3.55	-9.42	-6.54	
45	31.40	22.60	23.80	-1.30	-4.30	-4.50	30.63	20.83	27.80	-4.12	-11.87	-7.97	
60	31.60	22.00	22.20	-1.10	-4.90	-6.10	30.43	18.73	26.60	-4.32	-13.97	-9.17	
75	31.80	22.10	21.40	-0.90	-4.80	-6.90	30.34	16.96	25.55	-4.41	-15.74	-10.22	
90	30.90	21.20	21.20	-1.80	-5.70	-7.10	30.31	15.46	24.64	-4.44	-17.24	-11.13	
105	30.80	20.50	21.10	-1.90	-6.40	-7.20	30.33	14.19	23.84	-4.42	-18.51	-11.93	
120	31.00	18.00	20.80	-1.70	-8.90	-7.50	30.37	13.15	23.15	-4.38	-19.55	-12.62	
135	31.20	18.00	20.10	-1.50	-8.90	-8.20	30.42	12.28	22.54	-4.33	-20.42	-13.23	
150	30.90	18.00	20.00	-1.80	-8.90	-8.30	30.46	11.55	22.01	-4.29	-21.15	-13.76	
165	31.40	17.00	19.50	-1.30	-9.90	-8.80	30.49	10.96	21.55	-4.26	-21.74	-14.22	
180	31.70	16.00	19.00	-1.00	-10.90	-9.30	30.52	10.47	21.15	-4.23	-22.23	-14.62	
195	31.80	15.50	18.50	-0.90	-11.40	-9.80	30.55	10.06	20.80	-4.20	-22.64	-14.97	
210	31.90	15.00	17.50	-0.80	-11.90	-10.80	30.57	9.72	20.48	-4.18	-22.98	-15.29	
225	32.30	14.50	17.00	-0.40	-12.40	-11.30	30.58	9.44	20.21	-4.17	-23.26	-15.56	
240	32.80	14.00	16.50	0.10	-12.90	-11.80	30.60	9.21	19.97	-4.15	-23.49	-15.80	
255	32.60	13.50	15.50	-0.10	-13.40	-12.80	30.61	9.02	19.76	-4.14	-23.68	-16.01	
270	32.70	13.00	15.00	0.00	-13.90	-13.30	30.62	8.87	19.58	-4.13	-23.83	-16.19	

TABLE A12. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-5: subjects completing 4 to 5 hours immersion.

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HUMAN SUBJECT No.: 15			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 15						
SUIT: NORD 15			WATER TEMP: 31.01 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT*	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.10	31.00		0.00	0.00		34.75	32.70	35.77	0.00	0.00	0.00
15	30.60	29.40		-1.50	-1.60		31.87	26.18	31.06	-2.88	-6.52	-4.71
30	28.60	25.20	22.40	-3.50	-5.80	-6.40	30.23	23.21	29.17	-4.52	-9.49	-6.60
45	28.60	24.70	20.80	-3.50	-6.30	-8.00	29.38	20.80	27.74	-5.37	-11.90	-8.03
60	28.00	22.10	21.00	-4.10	-8.90	-7.80	28.85	18.74	26.53	-5.90	-13.96	-9.24
75	28.80	20.00	22.00	-3.30	-11.00	-6.80	28.52	16.97	25.49	-6.23	-15.73	-10.28
90	31.10	18.00	18.00	-1.00	-13.00	-10.80	28.30	15.50	24.59	-6.45	-17.20	-11.18
105	33.20	16.20	18.10	1.10	-14.80	-10.70	28.18	14.25	23.79	-6.57	-18.45	-11.98
120	34.10	14.80	17.50	2.00	-16.20	-11.30	28.10	13.22	23.10	-6.65	-19.48	-12.67
135	34.10	14.10	17.70	2.00	-16.90	-11.10	28.07	12.36	22.48	-6.68	-20.34	-13.29
150	34.70	13.60	15.90	2.60	-17.40	-12.90	28.06	11.64	21.94	-6.69	-21.06	-13.83
165	35.10	13.20	15.50	3.00	-17.80	-13.30	28.06	11.04	21.46	-6.69	-21.66	-14.31
180	35.10	12.60	15.00	3.00	-18.40	-13.80	28.07	10.54	21.04	-6.68	-22.16	-14.73
195	35.00	12.20	14.50	2.90	-18.80	-14.30	28.08	10.13	20.67	-6.67	-22.57	-15.10
210	34.90	12.00	14.10	2.80	-19.00	-14.70	28.09	9.78	20.34	-6.66	-22.92	-15.43
225	34.70	11.90	13.60	2.60	-19.10	-15.20	28.11	9.50	20.04	-6.64	-23.20	-15.73
240	34.70	11.20	12.80	2.60	-19.80	-16.00	28.12	9.26	19.79	-6.63	-23.44	-15.98
255	34.70	11.00	12.00	2.60	-20.00	-16.80	28.13	9.06	19.56	-6.62	-23.64	-16.21
270	34.60	10.70	11.10	2.50	-20.30	-17.70	28.14	8.90	19.35	-6.61	-23.80	-16.42
285	34.30	10.40	10.30	2.20	-20.60	-18.50	28.15	8.76	19.17	-6.60	-23.94	-16.60
300	33.80	11.00	10.00	1.70	-20.00	-18.80	28.15	8.64	19.01	-6.60	-24.06	-16.76

TABLE A13. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-5: subjects completing 4 to 5 hours immersion.
*: Data referenced to pre-immersion temperature (28.8C).

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HUMAN SUBJECT No.: 16				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 16					
SUIT: URSUIT				WATER TEMP: 31.55 deg F								
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
<hr/>												
0	34.00	26.10	29.20	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	33.70	24.00	27.40	-0.30	-2.10	-1.80	32.42	26.26	31.11	-2.33	-6.44	-4.66
30	33.10	22.00	25.60	-0.90	-4.10	-3.60	30.81	23.28	29.21	-3.94	-9.42	-6.56
45	33.10	19.00	23.70	-0.90	-7.10	-5.50	30.18	20.86	27.79	-4.57	-11.84	-7.98
60	32.60	17.50	22.20	-1.40	-8.60	-7.00	29.85	18.80	26.58	-4.90	-13.90	-9.19
75	32.20	16.00	20.60	-1.80	-10.10	-8.60	29.67	17.04	25.54	-5.08	-15.66	-10.23
90	32.60	15.00	19.00	-1.40	-11.10	-10.20	29.58	15.56	24.64	-5.17	-17.14	-11.13
105	32.70	14.50	18.00	-1.30	-11.60	-11.20	29.56	14.30	23.84	-5.19	-18.40	-11.93
120	31.00	13.50	16.50	-3.00	-12.60	-12.70	29.56	13.27	23.15	-5.19	-19.43	-12.62
135	32.70	13.00	15.00	-1.30	-13.10	-14.20	29.59	12.40	22.54	-5.16	-20.30	-13.23
150	33.10	12.00	14.00	-0.90	-14.10	-15.20	29.62	11.68	22.00	-5.13	-21.02	-13.77
165	33.10	11.50	13.00	-0.90	-14.60	-16.20	29.65	11.09	21.53	-5.10	-21.61	-14.24
180	32.60	11.00	12.00	-1.40	-15.10	-17.20	29.68	10.59	21.12	-5.07	-22.11	-14.65
195	32.80	10.50	11.50	-1.20	-15.60	-17.70	29.70	10.19	20.76	-5.05	-22.51	-15.01
210	31.90	11.00	10.50	-2.10	-15.10	-18.70	29.73	9.85	20.44	-5.02	-22.85	-15.33
225	31.60	10.50	10.00	-2.40	-15.60	-19.20	29.74	9.56	20.16	-5.01	-23.14	-15.61
240	31.20	10.50	10.00	-2.80	-15.60	-19.20	29.76	9.33	19.91	-4.99	-23.37	-15.86
255	31.60	10.00	7.00	-2.40	-16.10	-22.20	29.77	9.13	19.69	-4.98	-23.57	-16.08

TABLE A14. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-5: subjects completing 4 to 5 hours immersion.

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HUMAN SUBJECT No.: 9			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 9						
SUIT: HELLY HANSON			WATER TEMP: 31.01 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	30.10	29.60	28.20	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	27.70	28.40	26.40	-2.40	-1.20	-1.80	32.00	26.24	31.08	-2.75	-6.46	-4.69
30	27.60	26.80	25.20	-2.50	-2.80	-3.00	30.53	23.33	29.17	-4.22	-9.37	-6.60
45	26.00	24.60	24.00	-4.10	-5.00	-4.20	29.86	20.96	27.74	-4.89	-11.74	-8.03
60	25.80	22.50	23.40	-4.30	-7.10	-4.80	29.47	18.92	26.53	-5.28	-13.78	-9.24
75	26.80	20.20	22.10	-3.30	-9.40	-6.10	29.24	17.17	25.47	-5.51	-15.53	-10.30
90	26.40	19.00	20.40	-3.70	-10.60	-7.80	29.11	15.71	24.55	-5.64	-16.99	-11.22
105	27.40	17.00	18.00	-2.70	-12.60	-10.20	29.04	14.47	23.73	-5.71	-18.23	-12.04
120	29.00	15.00	16.40	-1.10	-14.60	-11.80	29.02	13.44	23.01	-5.73	-19.26	-12.76
135	29.00	14.80	14.90	-1.10	-14.80	-13.30	29.02	12.57	22.37	-5.73	-20.13	-13.40
150	28.10	12.40	13.40	-2.00	-17.20	-14.80	29.03	11.83	21.80	-5.72	-20.87	-13.97
165	26.70	13.70	12.30	-3.40	-15.90	-15.90	29.05	11.23	21.30	-5.70	-21.47	-14.47
180	27.00	13.90	11.70	-3.10	-15.70	-16.50	29.07	10.71	20.85	-5.68	-21.99	-14.92
195	27.30	13.60	11.00	-2.80	-16.00	-17.20	29.09	10.28	20.46	-5.66	-22.42	-15.31
210	26.40	12.20	10.00	-3.70	-17.40	-18.20	29.11	9.91	20.10	-5.64	-22.79	-15.67

TABLE A15. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-4: subjects completing 3 to 4 hours immersion.

HUMAN SUBJECT No.: 14			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 14						
SUIT: IMPERIAL			WATER TEMP: 30.45 deg F									
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	30.50	27.60	28.30	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	29.90	26.10	26.30	-0.60	-1.50	-2.00	31.90	26.18	31.03	-2.85	-6.52	-4.74
30	29.30	24.20	24.10	-1.20	-3.40	-4.20	30.42	23.25	29.11	-4.33	-9.45	-6.66
45	28.70	21.30	22.60	-1.80	-6.30	-5.70	29.72	20.87	27.67	-5.03	-11.83	-8.10
60	28.50	20.00	21.00	-2.00	-7.60	-7.30	29.31	18.81	26.45	-5.44	-13.89	-9.32
75	27.90	20.00	20.00	-2.60	-7.60	-8.30	29.06	17.06	25.39	-5.69	-15.64	-10.38
90	27.30	19.50	20.00	-3.20	-8.10	-8.30	28.92	15.59	24.46	-5.83	-17.11	-11.31
105	26.50	18.00	20.00	-4.00	-9.60	-8.30	28.84	14.35	23.63	-5.91	-18.35	-12.14
120	26.20	17.50	19.00	-4.30	-10.10	-9.30	28.81	13.31	22.90	-5.94	-19.39	-12.87
135	26.10	13.00	15.00	-4.40	-14.60	-13.30	28.80	12.43	22.25	-5.95	-20.27	-13.52
150	26.00	16.50	17.50	-4.50	-11.10	-10.80	28.81	11.68	21.67	-5.94	-21.02	-14.10
165	26.40	16.50	16.50	-4.10	-11.10	-11.80	28.83	11.07	21.16	-5.92	-21.63	-14.61
180	26.70	16.00	15.50	-3.80	-11.60	-12.80	28.85	10.54	20.71	-5.90	-22.16	-15.06
195	26.60	12.50	11.20	-3.90	-15.10	-17.10	28.87	10.11	20.31	-5.88	-22.59	-15.46
210	26.90	11.50	10.00	-3.60	-16.10	-18.30	28.88	9.74	19.95	-5.87	-22.96	-15.82

TABLE A16. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-4: subjects completing 3 to 4 hours immersion.

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HUMAN SUBJECT No.: 18 SEX: Male							MODEL PREDICTIONS for SUBJECT No.: 18					
SUIT: FITZ WRIGHT WATER TEMP: 31.28 deg F												
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	30.20	28.30	27.60	0.00	0.00	0.00	34.75	32.70	35.77	0.00	0.00	0.00
15	29.40	27.10	27.00	-0.80	-1.20	-0.60	32.60	26.32	31.15	-2.15	-6.38	-4.62
30	28.40	23.70	26.00	-1.80	-4.60	-1.60	31.10	23.35	29.21	-3.65	-9.35	-6.56
45	27.90	21.30	24.70	-2.30	-7.00	-2.90	30.51	20.93	27.78	-4.24	-11.77	-7.99
60	27.80	20.20	22.70	-2.40	-8.10	-4.90	30.28	18.86	26.57	-4.47	-13.84	-9.20
75	27.90	18.50	21.00	-2.30	-9.80	-6.60	30.17	17.09	25.51	-4.58	-15.61	-10.26
90	28.00	16.50	19.00	-2.20	-11.80	-8.60	30.12	15.61	24.59	-4.63	-17.09	-11.18
105	28.00	15.00	16.50	-2.20	-13.30	-11.10	30.12	14.35	23.77	-4.63	-18.35	-12.00
120	28.20	13.60	14.30	-2.00	-14.70	-13.30	30.15	13.31	23.05	-4.60	-19.39	-12.72
135	28.50	13.00	13.50	-1.70	-15.30	-14.10	30.18	12.44	22.41	-4.57	-20.26	-13.36
150	28.10	12.00	12.50	-2.10	-16.30	-15.10	30.22	11.71	21.85	-4.53	-20.99	-13.92
165	28.40	12.00	11.50	-1.80	-16.30	-16.10	30.26	11.10	21.37	-4.49	-21.60	-14.40
180	28.30	10.50	12.00	-1.90	-17.80	-15.60	30.28	10.59	20.93	-4.47	-22.11	-14.84
195	28.60	10.00	11.00	-1.60	-18.30	-16.60	30.31	10.17	20.55	-4.44	-22.53	-15.22

TABLE A17. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model Predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-4: subjects completing 3 to 4 hours immersion.

HUMAN SUBJECT No.: 21 SEX: Male							MODEL PREDICTIONS for SUBJECT No.: 21					
SUIT: LIUKKO WATER TEMP: 31.28 deg F												
TIME	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT	ABDOMEN	HAND	FOOT
min	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	33.20	23.00	22.30	0.00	0.00	0.00	34.75	32.69	35.77	0.00	0.00	0.00
15	32.90	20.20	22.00	-0.30	-2.80	-0.30	32.28	26.12	31.02	-2.47	-6.57	-4.75
30	33.40	19.50	20.10	0.20	-3.50	-2.20	30.68	23.09	29.08	-4.07	-9.60	-6.69
45	33.70	17.50	20.50	0.50	-5.50	-1.80	30.04	20.63	27.64	-4.71	-12.06	-8.13
60	33.90	18.00	19.00	0.70	-5.00	-3.30	29.70	18.53	26.41	-5.05	-14.16	-9.36
75	34.10	14.50	18.50	0.90	-8.50	-3.80	29.51	16.74	25.35	-5.24	-15.95	-10.42
90	34.40	14.00	17.00	1.20	-9.00	-5.30	29.42	15.23	24.43	-5.33	-17.46	-11.34
105	34.30	13.50	16.50	1.10	-9.50	-5.80	29.39	13.96	23.62	-5.36	-18.73	-12.15
120	34.40	18.00	19.00	1.20	-5.00	-3.30	29.39	12.91	22.91	-5.36	-19.78	-12.86
135	34.60	13.00	15.00	1.40	-10.00	-7.30	29.42	12.03	22.29	-5.33	-20.66	-13.48
150	33.50	16.50	17.50	0.30	-6.50	-4.80	29.45	11.30	21.74	-5.30	-21.39	-14.03
165	34.30	16.50	16.50	1.10	-6.50	-5.80	29.48	10.70	21.26	-5.27	-21.99	-14.51
180	33.30	16.00	15.50	0.10	-7.00	-6.80	29.51	10.19	20.84	-5.24	-22.50	-14.93
195	33.80	12.50	8.50	0.60	-10.50	-13.80	29.53	9.77	20.47	-5.22	-22.92	-15.30
210	24.00	11.50	8.50	-9.20	-11.50	-13.80	29.55	9.42	20.14	-5.20	-23.27	-15.63

TABLE A18. Comparison of human abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P1-4: subjects completing 3 to 4 hours immersion.

HUMAN SUBJECT No.: 11			SEX: Female		MODEL PREDICTIONS for SUBJECT No.: 11							
SUIT: FITZ WRIGHT			WATER TEMP: 31.28 deg F									
TIME	RECTAL	ABDOMEN	HAND	FOOT	RECTAL	ABDOMEN	HAND	FOOT	RECTAL	ABDOMEN	HAND	FOOT
min	(Actual temp.)	(Actual temp.)	(Actual temp.)	(Actual temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)
0	37.80	30.80	28.70	27.80	0.00	0.00	0.00	0.00	37.01	34.75	32.76	35.77
15	37.80	29.30	26.80	26.20	0.00	-1.50	-1.90	-1.60	37.10	31.92	26.21	31.08
30	37.70	29.00	24.10	24.90	-0.10	-1.80	-4.60	-2.90	37.09	30.25	23.28	29.20
45	37.70	22.60	18.00	21.50	-0.10	-8.20	-10.70	-6.30	37.03	29.37	20.88	27.77
60	37.60	25.60	18.00	21.80	-0.20	-5.20	-10.70	-6.00	36.95	28.83	18.84	26.58
75	37.50	26.20	17.00	20.00	-0.30	-4.60	-11.70	-7.80	36.86	28.48	17.10	25.55
90	37.40	25.90	16.50	19.00	-0.40	-4.90	-12.20	-8.80	36.76	28.24	15.63	24.64
105	37.20	25.10	15.00	18.00	-0.60	-5.70	-13.70	-9.80	36.68	28.10	14.40	23.85
120	37.20	24.90	14.00	17.00	-0.60	-5.90	-14.70	-10.80	36.62	28.01	13.37	23.15
135	37.10	26.10	13.50	16.00	-0.70	-4.70	-15.20	-11.80	36.57	27.97	12.51	22.54
150	36.90	26.10	13.50	14.60	-0.90	-4.70	-15.20	-13.20	36.54	27.95	11.80	21.99
165	36.90	26.30	12.50	13.50	-0.90	-4.50	-16.20	-14.30	36.51	27.95	11.20	21.51
180	36.80	26.30	12.00	12.50	-1.00	-4.50	-16.70	-15.30	36.49	27.96	10.71	21.09
195	36.80	26.30	11.50	11.50	-1.00	-4.50	-17.20	-16.30	36.48	27.97	10.29	20.71
210	36.70	25.50	12.00	11.00	-1.10	-5.30	-16.70	-16.80	36.47	27.98	9.95	20.37
225	36.60	25.10	13.00	10.00	-1.20	-5.70	-15.70	-17.80	36.47	27.98	9.67	20.08
240	36.60	25.60	13.00	9.50	-1.20	-5.20	-15.70	-18.30	36.46	28.01	9.43	19.81

TABLE A19. Comparison of human rectal, abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given.
Data not used in statistical analysis.

HUMAN SUBJECT No.: 12				SEX: Male		MODEL PREDICTIONS for SUBJECT No.: 12													
SUIT:		UNSUIT		WATER TEMP:		30.45 deg F													
TIME	RECTAL	ABDOMEN	HAND	FOOT	RECTAL	ABDOMEN	HAND	FOOT	RECTAL	ABDOMEN	HAND	FOOT	RECTAL	ABDOMEN	HAND	FOOT			
min	(Actual temp.)				(Change in temp.)				(Actual temp.)				(Change in temp.)						
0	37.20	31.10	25.80	24.90	0.00	0.00	0.00	0.00	0.00	37.01	34.75	32.69	35.77	0.00	0.00	0.00	0.00		
15	37.30	31.00	23.40	23.70	0.10	-0.10	-2.40	-1.20	37.08	32.60	26.15	31.06	0.07	-2.15	-6.54	-4.71			
30	37.10	30.60	20.80	22.10	-0.10	-0.50	-5.00	-2.80	36.97	31.07	23.07	29.10	-0.04	-3.68	-9.62	-6.67			
45	36.80	30.70	20.50	20.70	-0.40	-0.40	-5.30	-4.20	36.68	30.51	20.57	27.65	-0.33	-4.24	-12.12	-8.12			
60	36.70	29.60	19.00	20.10	-0.50	-1.50	-6.80	-4.80	36.45	30.29	18.44	26.42	-0.56	-4.46	-14.25	-9.35			
75	36.60	28.50	18.00	20.00	-0.60	-2.60	-7.80	-4.90	36.28	30.19	16.64	25.35	-0.73	-4.56	-16.05	-10.42			
90	36.50	27.90	16.00	20.00	-0.70	-3.20	-9.80	-4.90	36.15	30.16	15.11	24.43	-0.86	-4.59	-17.58	-11.34			
105	36.30	27.70	16.00	20.00	-0.90	-3.40	-9.80	-4.90	36.06	30.17	13.82	23.62	-0.95	-4.58	-18.87	-12.15			
120	36.10	27.90	15.00	19.00	-1.10	-3.20	-10.80	-5.90	35.99	30.21	12.76	22.92	-1.02	-4.54	-19.93	-12.85			
135	36.10	28.10	15.00	19.00	-1.10	-3.00	-10.80	-5.90	35.95	30.26	11.87	22.30	-1.06	-4.49	-20.82	-13.47			

TABLE A20. Comparison of human rectal, abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given.
Data not used in statistical analysis.

HUMAN SUBJECT No.: 20				SEX: Male		MODEL PREDICTIONS for SUBJECT No.: 20										
SUIT: LIUKKO		WATER TEMP:		31.28 deg F												
TIME	RECTAL	ABDOMEN	HAND	FOOT	RECTAL	ABDOMEN	HAND	FOOT	RECTAL	ABDOMEN	HAND	FOOT				
min	(Actual temp.)				(Change in temp.)				(Actual temp.)				(Change in temp.)			
0	38.00	32.60	29.00	25.90	0.00	0.00	0.00	0.00	37.01	34.75	32.71	35.78	0.00	0.00	0.00	0.00
15	37.90	32.00	26.40	24.00	-0.10	-0.60	-2.60	-1.90	37.09	31.85	26.29	31.12	0.08	-2.90	-6.42	-4.66
30	37.70	32.80	24.40	22.50	-0.30	0.20	-4.60	-3.40	37.05	30.29	23.39	29.22	0.04	-4.46	-9.32	-6.56
45	37.50	32.60	21.70	20.40	-0.50	0.00	-7.30	-5.50	36.94	29.49	21.04	27.80	-0.07	-5.26	-11.67	-7.98
60	37.40	32.30	20.30	18.50	-0.60	-0.30	-8.70	-7.40	36.81	28.99	19.01	26.60	-0.20	-5.76	-13.70	-9.18
75	37.30	32.00	19.00	17.50	-0.70	-0.60	-10.00	-8.40	36.67	28.68	17.28	25.55	-0.34	-6.07	-15.43	-10.23
90	37.30	32.10	18.00	16.50	-0.70	-0.50	-11.00	-9.40	36.54	28.48	15.83	24.64	-0.47	-6.27	-16.88	-11.14
105	37.30	30.70	16.50	14.50	-0.70	-1.90	-12.50	-11.40	36.43	28.35	14.60	23.83	-0.58	-6.40	-18.11	-11.95
120	37.20	30.10	15.30	13.20	-0.80	-2.50	-13.70	-12.70	36.35	28.29	13.58	23.12	-0.66	-6.46	-19.13	-12.66
135	37.10	29.70	14.50	12.00	-0.90	-2.90	-14.50	-13.90	36.28	28.25	12.72	22.48	-0.73	-6.50	-19.99	-13.30
150	37.00	29.70	14.00	11.00	-1.00	-2.90	-15.00	-14.90	36.23	28.24	11.99	21.91	-0.78	-6.51	-20.72	-13.87
165	37.00	29.90	13.50	9.80	-1.00	-2.70	-15.50	-16.10	36.19	28.25	11.39	21.42	-0.82	-6.50	-21.32	-14.36

TABLE A21. Comparison of human rectal, abdomen, hand and foot temperatures (degrees C) from Pelapu 1 with Model predictions. Actual temperatures and change from initial temperatures are given.
Data not used in statistical analysis.

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HUMAN SUBJECT No.: 8				SEX: Female				MODEL PREDICTIONS for SUBJECT No.: 8						
SUIT: URSUIT 5001				WATER TEMP: 31.37 deg F										
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST
min	mean	right		BACK	mean	right		BACK						
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)		
0	31.65	31.30	33.30	32.60	0.00	0.00	0.00	0.00	32.69	32.75	33.79	0.00	0.00	0.00
10	30.75	31.30	33.90	32.10	-0.90	0.00	0.60	-0.50	27.46	27.94	31.05	-5.23	-4.81	-2.74
20	29.15	30.60	33.80	31.90	-2.50	-0.70	0.50	-0.70	25.12	26.11	29.88	-7.57	-6.64	-3.91
30	27.00	30.20	33.50	31.60	-4.65	-1.10	0.20	-1.00	23.17	25.45	29.74	-9.52	-7.30	-4.05
40	25.55	29.70	33.10	31.40	-6.10	-1.60	-0.20	-1.20	21.48	25.57	30.08	-11.21	-7.18	-3.71
50	24.00	29.70	32.80	31.40	-7.65	-1.60	-0.50	-1.20	19.98	25.71	30.25	-12.71	-7.04	-3.54
60	23.10	29.20	32.80	31.40	-8.55	-2.10	-0.50	-1.20	18.63	25.82	30.32	-14.06	-6.93	-3.47
70	22.35	29.00	32.80	31.40	-9.30	-2.30	-0.50	-1.20	17.43	25.94	30.36	-15.26	-6.81	-3.43
80	21.35	29.10	32.90	31.70	-10.30	-2.20	-0.40	-0.90	16.35	26.07	30.39	-16.34	-6.68	-3.40
90	20.45	28.80	32.90	32.20	-11.20	-2.50	-0.40	-0.40	15.37	26.19	30.40	-17.32	-6.56	-3.39
100	19.80	28.40	33.40	32.40	-11.85	-2.90	0.10	-0.20	14.50	26.28	30.41	-18.19	-6.47	-3.38
110	19.15	28.10	34.60	32.60	-12.50	-3.20	1.30	0.00	13.74	26.36	30.42	-18.95	-6.39	-3.37
120	18.75	27.80	33.70	32.60	-12.90	-3.50	0.40	0.00	13.05	26.43	30.42	-19.64	-6.32	-3.37
130	18.15	27.40	33.60	32.50	-13.50	-3.90	0.30	-0.10	12.46	26.48	30.42	-20.23	-6.27	-3.37
140	17.85	27.40	33.80	32.40	-13.80	-3.90	0.50	-0.20	11.94	26.52	30.43	-20.75	-6.23	-3.36
150	17.75	26.80	33.80	32.40	-13.90	-4.50	0.50	-0.20	11.47	26.55	30.43	-21.22	-6.20	-3.36
160	17.35	27.20	34.10	32.40	-14.30	-4.10	0.80	-0.20	11.07	26.57	30.44	-21.62	-6.18	-3.35
170	17.15	27.00	34.00	32.20	-14.50	-4.30	0.70	-0.40	10.71	26.59	30.44	-21.98	-6.16	-3.35
180	17.05	27.00	34.00	32.00	-14.60	-4.30	0.70	-0.60	10.40	26.61	30.44	-22.29	-6.14	-3.35

TABLE A22. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 8			SEX: Female		MODEL PREDICTIONS for SUBJECT No.: 8								
SUIT:	URSUIT	5001	WATER TEMP:		31.37 deg F								
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	
min	mean		right	mean		right							
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)			
0	31.50	29.50	30.10	0.00	0.00	0.00	35.77	32.98	33.61	0.00	0.00	0.00	
10	31.00	26.50	27.50	-0.50	-3.00	-2.60	31.96	29.50	29.61	-3.81	-3.48	-4.00	
20	30.60	24.40	25.30	-0.90	-5.10	-4.80	30.39	28.56	28.46	-5.38	-4.42	-5.15	
30	29.50	22.90	23.70	-2.00	-6.60	-6.40	29.20	27.87	27.86	-6.57	-5.11	-5.75	
40	27.55	21.70	22.70	-3.95	-7.80	-7.40	28.22	27.31	27.57	-7.55	-5.67	-6.04	
50	26.35	20.80	21.90	-5.15	-8.70	-8.20	27.36	26.80	27.39	-8.41	-6.18	-6.22	
60	24.20	20.00	21.40	-7.30	-9.50	-8.70	26.57	26.33	27.24	-9.20	-6.65	-6.37	
70	22.90	19.40	21.10	-8.60	-10.10	-9.00	25.87	25.91	27.14	-9.90	-7.07	-6.47	
80	22.60	18.90	20.80	-8.90	-10.60	-9.30	25.24	25.52	27.07	-10.53	-7.46	-6.54	
90	23.80	18.40	20.80	-7.70	-11.10	-9.30	24.65	25.17	27.02	-11.12	-7.81	-6.59	
100	21.75	18.10	21.10	-9.75	-11.40	-9.00	24.12	24.85	26.99	-11.65	-8.13	-6.62	
110	25.30	17.90	21.10	-6.20	-11.60	-9.00	23.64	24.56	26.96	-12.13	-8.42	-6.65	
120	26.10	17.70	21.00	-5.40	-11.80	-9.10	23.19	24.29	26.95	-12.58	-8.69	-6.66	
130	24.75	17.60	21.00	-6.75	-11.90	-9.10	22.79	24.06	26.94	-12.98	-8.92	-6.67	
140	25.10	17.50	20.90	-6.40	-12.00	-9.20	22.43	23.84	26.93	-13.34	-9.14	-6.68	
150	25.25	17.40	20.70	-6.25	-12.10	-9.40	22.09	23.65	26.92	-13.68	-9.33	-6.69	
160	25.45	17.20	20.50	-6.05	-12.30	-9.60	21.78	23.48	26.91	-13.99	-9.50	-6.70	
170	24.95	17.00	20.30	-6.55	-12.50	-9.80	21.50	23.32	26.91	-14.27	-9.66	-6.70	
180	24.95	16.80	20.10	-6.55	-12.70	-10.00	21.24	23.17	26.91	-14.53	-9.81	-6.70	

TABLE A23. Comparison of human lower body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 9				SEX: Female				MODEL PREDICTIONS for SUBJECT No.: 9						
SUIT: URSUIT 5001				WATER TEMP: 31.37 deg F										
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST
min	mean	right		BACK	mean	right		BACK						
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)		
0	32.90	33.70	34.60	33.80	0.00	0.00	0.00	0.00	32.69	32.75	33.79	0.00	0.00	0.00
10	32.60	31.70	34.20	31.60	-0.30	-2.00	-0.40	-2.20	27.47	28.13	31.34	-5.22	-4.62	-2.45
20	30.80	30.40	33.60	30.40	-2.10	-3.30	-1.00	-3.40	25.12	26.33	30.23	-7.57	-6.42	-3.56
30	29.40	29.40	32.00	29.70	-3.50	-4.30	-2.60	-4.10	23.16	25.59	30.01	-9.53	-7.16	-3.78
40	28.70	28.90	32.60	29.40	-4.20	-4.80	-2.00	-4.40	21.46	25.84	30.44	-11.23	-6.91	-3.35
50	27.05	27.80	31.80	28.60	-5.85	-5.90	-2.80	-5.20	19.95	26.19	30.70	-12.74	-6.56	-3.09
60	25.65	27.30	31.50	28.30	-7.25	-6.40	-3.10	-5.50	18.58	26.43	30.79	-14.11	-6.32	-3.00
70	24.80	27.20	30.80	28.20	-8.10	-6.50	-3.80	-5.60	17.38	26.61	30.83	-15.31	-6.14	-2.96
80	23.95	27.40	30.60	28.20	-8.95	-6.30	-4.00	-5.60	16.30	26.76	30.85	-16.39	-5.99	-2.94
90	22.95	27.10	30.30	28.10	-9.95	-6.60	-4.30	-5.70	15.32	26.88	30.86	-17.37	-5.87	-2.93
100	22.20	27.20	29.80	28.10	-10.70	-6.50	-4.80	-5.70	14.45	26.98	30.86	-18.24	-5.77	-2.93
110	21.50	27.00	30.10	28.10	-11.40	-6.70	-4.50	-5.70	13.68	27.05	30.87	-19.01	-5.70	-2.92
120	20.70	26.70	30.10	28.10	-12.20	-7.00	-4.50	-5.70	12.99	27.11	30.87	-19.70	-5.64	-2.92
130	20.50	26.90	29.70	28.00	-12.40	-6.80	-4.90	-5.80	12.39	27.15	30.87	-20.30	-5.60	-2.92
140	19.85	27.00	29.90	28.10	-13.05	-6.70	-4.70	-5.70	11.86	27.19	30.88	-20.83	-5.56	-2.91
150	19.50	27.20	30.00	28.10	-13.40	-6.50	-4.60	-5.70	11.40	27.22	30.88	-21.29	-5.53	-2.91
160	19.75	27.20	29.80	28.20	-13.15	-6.50	-4.80	-5.60	10.99	27.24	30.89	-21.70	-5.51	-2.90
170	18.85	27.00	29.50	27.50	-14.05	-6.70	-5.10	-6.30	10.64	27.26	30.89	-22.05	-5.49	-2.90
180	19.00	27.30	29.20	27.30	-13.90	-6.40	-5.40	-6.50	10.32	27.27	30.90	-22.37	-5.48	-2.89
190	19.50	27.20	28.80	27.20	-13.40	-6.50	-5.80	-6.60	10.05	27.28	30.90	-22.64	-5.47	-2.89
200	19.30	27.20	29.20	27.30	-13.60	-6.50	-5.40	-6.50	9.81	27.29	30.90	-22.88	-5.46	-2.89
210	19.90	27.50	29.50	26.90	-13.00	-6.20	-5.10	-6.90	9.59	27.30	30.91	-23.10	-5.45	-2.88
220	19.90	26.80	29.70	28.70	-13.00	-6.90	-4.90	-5.10	9.41	27.31	30.91	-23.28	-5.44	-2.88
230	19.60	26.60	29.30	25.70	-13.30	-7.10	-5.30	-8.10	9.24	27.32	30.92	-23.45	-5.43	-2.87
240	19.25	26.60	29.20	24.00	-13.65	-7.10	-5.40	-9.80	9.10	27.32	30.92	-23.59	-5.43	-2.87
250	18.5	26.30	29.10	23.60	-13.95	-7.40	-5.50	-10.20	8.97	27.33	30.92	-23.72	-5.42	-2.87
260	18.45	26.00	28.90	22.80	-14.45	-7.70	-5.70	-11.00	8.86	27.33	30.92	-23.83	-5.42	-2.87
270	18.30	25.80	29.10	22.00	-14.60	-7.90	-5.50	-11.80	8.77	27.34	30.93	-23.92	-5.41	-2.86
280	18.20	25.50	28.90	20.90	-14.70	-8.20	-5.70	-12.90	8.68	27.34	30.93	-24.01	-5.41	-2.86
290	17.60	25.30	29.30	22.30	-15.30	-8.40	-5.30	-11.50	8.61	27.34	30.93	-24.08	-5.41	-2.86
300	17.45	25.30	29.50	22.00	-15.45	-8.40	-5.10	-11.80	8.54	27.34	30.93	-24.15	-5.41	-2.86
310	17.30	25.20	29.50	22.10	-15.60	-8.50	-5.10	-11.70	8.48	27.35	30.93	-24.21	-5.40	-2.86
320	17.40	24.60	29.30	21.80	-15.50	-9.10	-5.30	-12.00	8.43	27.35	30.93	-24.26	-5.40	-2.86
330	16.85	24.70	29.60	22.50	-16.05	-9.00	-5.00	-11.30	8.39	27.35	30.93	-24.30	-5.40	-2.86
340	16.80	24.40	29.40	21.40	-16.10	-9.30	-5.20	-12.40	8.35	27.35	30.93	-24.34	-5.40	-2.86
350	16.90	24.10	29.50	22.30	-16.00	-9.60	-5.10	-11.50	8.32	27.35	30.93	-24.37	-5.40	-2.86
360	16.70	24.30	29.90	22.70	-16.20	-9.40	-4.70	-11.10	8.29	27.35	30.93	-24.40	-5.40	-2.86

TABLE A24. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 9			SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 9						
SUIT: UNSUIT 5001			WATER TEMP: 31.37 deg F									
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
min	mean		right	mean		right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	33.80	30.10	29.40	0.00	0.00	0.00	35.76	32.98	33.61	0.00	0.00	0.00
10	32.55	26.20	25.30	-1.25	-3.90	-4.10	31.97	29.89	29.97	-3.79	-3.09	-3.64
20	31.30	24.40	23.50	-2.50	-5.70	-5.90	30.39	29.01	28.94	-5.37	-3.97	-4.67
30	30.45	23.30	22.30	-3.35	-6.80	-7.10	29.19	28.33	28.40	-6.57	-4.65	-5.21
40	29.95	22.80	21.70	-3.85	-7.30	-7.70	28.21	27.76	28.19	-7.55	-5.22	-5.42
50	28.95	21.30	20.80	-4.85	-8.80	-8.60	27.35	27.26	28.09	-8.41	-5.72	-5.52
60	27.90	20.40	20.20	-5.90	-9.70	-9.20	26.56	26.79	28.00	-9.20	-6.19	-5.61
70	27.00	20.00	20.00	-6.80	-10.10	-9.40	25.86	26.37	27.94	-9.90	-6.61	-5.67
80	26.35	19.80	19.80	-7.45	-10.30	-9.60	25.22	25.98	27.90	-10.54	-7.00	-5.71
90	25.50	19.00	19.50	-8.30	-11.10	-9.90	24.63	25.63	27.87	-11.13	-7.35	-5.74
100	24.80	18.40	19.50	-9.00	-11.70	-9.90	24.11	25.32	27.85	-11.65	-7.66	-5.76
110	23.70	17.80	19.50	-10.10	-12.30	-9.90	23.63	25.04	27.84	-12.13	-7.94	-5.77
120	23.00	17.60	19.50	-10.80	-12.50	-9.90	23.18	24.78	27.84	-12.58	-8.20	-5.77
130	22.75	17.50	19.70	-11.05	-12.60	-9.70	22.78	24.55	27.83	-12.98	-8.43	-5.78
140	22.35	17.40	19.60	-11.45	-12.70	-9.80	22.42	24.35	27.83	-13.34	-8.63	-5.78
150	21.40	17.40	19.40	-12.40	-12.70	-10.00	22.08	24.16	27.83	-13.68	-8.82	-5.78
160	21.10	17.30	19.40	-12.70	-12.80	-10.00	21.78	23.99	27.83	-13.98	-8.99	-5.78
170	19.50	16.40	18.80	-14.30	-13.70	-10.60	21.50	23.84	27.83	-14.26	-9.14	-5.78
180	18.90	15.90	18.80	-14.90	-14.20	-10.60	21.25	23.71	27.83	-14.51	-9.27	-5.78
190	18.55	16.30	18.80	-15.25	-13.80	-10.60	21.01	23.58	27.82	-14.75	-9.40	-5.79
200	18.30	16.30	18.90	-15.50	-13.80	-10.50	20.80	23.47	27.82	-14.96	-9.51	-5.79
210	17.90	16.10	18.70	-15.90	-14.00	-10.70	20.61	23.37	27.82	-15.15	-9.61	-5.79
220	18.05	15.80	18.70	-15.75	-14.30	-10.70	20.43	23.28	27.82	-15.33	-9.70	-5.79
230	17.30	15.70	18.50	-16.50	-14.40	-10.90	20.26	23.19	27.82	-15.50	-9.79	-5.79
240	16.90	15.90	18.50	-16.90	-14.20	-10.90	20.11	23.12	27.82	-15.65	-9.86	-5.79
250	16.50	15.80	18.60	-17.30	-14.30	-10.80	19.97	23.05	27.82	-15.79	-9.93	-5.79
260	16.55	16.00	18.80	-17.25	-14.10	-10.60	19.85	22.98	27.82	-15.91	-10.00	-5.79
270	16.55	15.80	18.90	-17.25	-14.30	-10.50	19.73	22.92	27.82	-16.03	-10.06	-5.79
280	16.40	15.80	18.90	-17.40	-14.30	-10.50	19.62	22.87	27.82	-16.14	-10.11	-5.79
290	15.80	15.70	19.10	-18.00	-14.40	-10.30	19.53	22.82	27.82	-16.23	-10.16	-5.79
300	15.65	16.10	19.30	-18.15	-14.00	-10.10	19.44	22.78	27.82	-16.32	-10.20	-5.79
310	15.60	15.90	19.10	-18.20	-14.20	-10.30	19.35	22.74	27.82	-16.41	-10.24	-5.79
320	14.85	15.50	19.40	-18.95	-14.60	-10.00	19.28	22.70	27.81	-16.48	-10.28	-5.80
330	14.85	15.40	19.40	-18.95	-14.70	-10.00	19.21	22.66	27.81	-16.55	-10.32	-5.80
340	14.95	15.50	19.30	-18.85	-14.60	-10.10	19.14	22.63	27.81	-16.62	-10.35	-5.80
350	14.85	15.20	19.30	-18.95	-14.90	-10.10	19.08	22.60	27.81	-16.68	-10.38	-5.80
360	14.80	15.30	19.30	-19.00	-14.80	-10.10	19.03	22.58	27.81	-16.73	-10.40	-5.80

TABLE A25. Comparison of human lower body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 14				SEX: Female				MODEL PREDICTIONS for SUBJECT No.: 14						
SUIT: URSUIT 5001				WATER TEMP: 31.37 deg F										
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST
min	mean	right		BACK	mean	right		BACK						
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)		
0	30.40	32.20	36.00	33.60	0.00	0.00	0.00	0.00	32.69	32.75	33.79	0.00	0.00	0.00
10	29.45	30.90	35.80	32.80	-0.95	-1.30	-0.20	-0.80	27.45	27.66	30.59	-5.24	-5.09	-3.20
20	28.75	30.10	35.30	32.30	-1.65	-2.10	-0.70	-1.30	25.11	25.72	29.23	-7.58	-7.03	-4.56
30	27.45	28.00	35.20	32.20	-2.95	-4.20	-0.80	-1.40	23.17	24.96	29.04	-9.52	-7.79	-4.75
40	26.50	27.60	35.00	32.30	-3.90	-4.60	-1.00	-1.30	21.49	24.75	29.16	-11.20	-8.00	-4.63
50	25.45	26.70	34.60	32.40	-4.95	-5.50	-1.40	-1.20	20.00	24.71	29.28	-12.69	-8.04	-4.51
60	23.10	25.20	34.30	32.80	-7.30	-7.00	-1.70	-0.80	18.65	24.72	29.36	-14.04	-8.03	-4.43
70	22.15	24.90	34.20	32.90	-8.25	-7.30	-1.80	-0.70	17.46	24.76	29.40	-15.23	-7.99	-4.39
80	21.10	24.10	34.00	32.90	-9.30	-8.10	-2.00	-0.70	16.39	24.80	29.43	-16.30	-7.95	-4.36
90	20.15	23.30	33.30	32.80	-10.25	-8.90	-2.70	-0.80	15.41	24.86	29.45	-17.28	-7.89	-4.34
100	19.55	23.00	33.60	32.90	-10.85	-9.20	-2.40	-0.70	14.55	24.93	29.46	-18.14	-7.82	-4.33
110	18.85	23.10	33.20	32.80	-11.55	-9.10	-2.80	-0.80	13.79	24.99	29.47	-18.90	-7.76	-4.32
120	17.95	22.80	33.20	31.90	-12.45	-9.40	-2.80	-1.70	13.11	25.05	29.48	-19.58	-7.70	-4.31
130	17.15	22.60	33.30	30.60	-13.25	-9.60	-2.70	-3.00	12.52	25.10	29.49	-20.17	-7.65	-4.30
140	16.95	21.80	33.60	29.80	-13.45	-10.40	-2.40	-3.80	12.01	25.14	29.49	-20.68	-7.61	-4.30
150	16.35	21.80	33.30	29.00	-14.05	-10.40	-2.70	-4.60	11.54	25.18	29.50	-21.15	-7.57	-4.29
160	16.20	21.60	33.40	28.10	-14.20	-10.60	-2.60	-5.50	11.14	25.21	29.50	-21.55	-7.54	-4.29
170	16.05	21.30	33.90	27.60	-14.35	-10.90	-2.10	-6.00	10.79	25.24	29.51	-21.90	-7.51	-4.28
180	15.85	20.30	34.10	27.20	-14.55	-11.90	-1.90	-6.40	10.47	25.26	29.51	-22.22	-7.49	-4.28
190	15.55	19.80	34.00	26.80	-14.85	-12.40	-2.00	-6.80	10.20	25.27	29.51	-22.49	-7.48	-4.28
200	15.95	19.40	33.70	26.80	-14.45	-12.80	-2.30	-6.80	9.96	25.29	29.51	-22.73	-7.46	-4.28
210	15.90	19.10	33.70	26.40	-14.50	-13.10	-2.30	-7.20	9.75	25.30	29.52	-22.94	-7.45	-4.27
220	15.90	18.50	33.80	25.80	-14.50	-13.70	-2.20	-7.80	9.56	25.31	29.52	-23.13	-7.44	-4.27
230	15.90	18.00	34.60	25.30	-14.50	-14.20	-1.40	-8.30	9.40	25.32	29.52	-23.29	-7.43	-4.27
240	15.95	17.80	34.10	25.30	-14.45	-14.40	-1.90	-8.30	9.25	25.33	29.53	-23.44	-7.42	-4.26
250	15.35	17.40	33.90	25.10	-15.05	-14.80	-2.10	-8.50	9.13	25.33	29.53	-23.56	-7.42	-4.26
260	15.90	17.30	34.30	25.00	-14.50	-14.90	-1.70	-8.60	9.02	25.34	29.53	-23.67	-7.41	-4.26
270	15.90	17.40	34.30	25.00	-14.50	-14.80	-1.70	-8.60	8.92	25.34	29.53	-23.77	-7.41	-4.26
280	15.65	16.60	33.90	24.90	-14.75	-15.60	-2.10	-8.70	8.83	25.35	29.53	-23.86	-7.40	-4.26
290	15.60	16.30	33.80	24.60	-14.80	-15.90	-2.20	-9.00	8.76	25.35	29.53	-23.93	-7.40	-4.26
300	15.45	16.00	33.80	24.60	-14.95	-16.20	-2.20	-9.00	8.69	25.35	29.53	-24.00	-7.40	-4.26

TABLE A26. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 14 SEX: Female							MODEL PREDICTIONS for SUBJECT No.: 14					
SUIT: URSUIT 5001 WATER TEMP: 31.37 deg F												
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
min	mean		right	mean		right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	26.60	30.50	29.20	0.00	0.00	0.00	35.77	32.98	33.61	0.00	0.00	0.00
10	25.65	29.80	27.10	-0.95	-0.70	-2.10	31.96	29.08	29.20	-3.81	-3.90	-4.41
20	24.55	29.40	25.90	-2.05	-1.10	-3.30	30.39	28.00	27.76	-5.38	-4.98	-5.85
30	23.55	28.70	24.90	-3.05	-1.80	-4.30	29.22	27.26	26.94	-6.55	-5.72	-6.67
40	22.60	28.10	24.40	-4.00	-2.40	-4.80	28.24	26.68	26.46	-7.53	-6.30	-7.15
50	21.70	27.40	23.80	-4.90	-3.10	-5.40	27.38	26.16	26.14	-8.39	-6.82	-7.47
60	20.80	26.60	23.40	-5.80	-3.90	-5.80	26.61	25.70	25.91	-9.16	-7.28	-7.70
70	19.85	26.00	23.20	-6.75	-4.50	-6.00	25.91	25.27	25.74	-9.86	-7.71	-7.87
80	19.00	25.40	23.00	-7.60	-5.10	-6.20	25.28	24.88	25.60	-10.49	-8.10	-8.01
90	18.10	24.90	22.80	-8.50	-5.60	-6.40	24.70	24.52	25.50	-11.07	-8.46	-8.11
100	17.90	25.00	22.80	-8.70	-5.50	-6.40	24.18	24.20	25.42	-11.59	-8.78	-8.19
110	17.55	25.00	22.40	-9.05	-5.50	-6.80	23.70	23.90	25.35	-12.07	-9.08	-8.26
120	16.85	24.50	22.00	-9.75	-6.00	-7.20	23.26	23.63	25.31	-12.51	-9.35	-8.30
130	16.70	24.20	21.80	-9.90	-6.30	-7.40	22.86	23.38	25.27	-12.91	-9.60	-8.34
140	17.05	24.10	21.60	-9.55	-6.40	-7.60	22.49	23.16	25.24	-13.28	-9.82	-8.37
150	16.85	23.90	20.90	-9.75	-6.60	-8.30	22.15	22.96	25.22	-13.62	-10.02	-8.39
160	16.45	23.30	21.00	-10.15	-7.20	-8.20	21.85	22.77	25.20	-13.92	-10.21	-8.41
170	16.75	22.80	21.00	-9.85	-7.70	-8.20	21.56	22.61	25.19	-14.21	-10.37	-8.42
180	16.90	22.60	20.80	-9.70	-7.90	-8.40	21.30	22.45	25.17	-14.47	-10.53	-8.44
190	16.85	22.30	20.70	-9.75	-8.20	-8.50	21.06	22.31	25.16	-14.71	-10.67	-8.45
200	16.10	22.00	20.80	-10.50	-8.50	-8.40	20.85	22.19	25.15	-14.92	-10.79	-8.46
210	15.45	21.90	20.90	-11.15	-8.60	-8.30	20.64	22.07	25.15	-15.13	-10.91	-8.46
220	14.95	21.90	20.90	-11.65	-8.60	-8.30	20.46	21.97	25.14	-15.31	-11.01	-8.47
230	14.65	21.70	20.80	-11.95	-8.80	-8.40	20.29	21.87	25.14	-15.48	-11.11	-8.47
240	14.65	21.70	20.90	-11.95	-8.80	-8.30	20.13	21.78	25.13	-15.64	-11.20	-8.48
250	15.55	21.40	21.00	-11.05	-9.10	-8.20	19.98	21.70	25.13	-15.79	-11.28	-8.48
260	16.05	21.30	21.00	-10.55	-9.20	-8.20	19.85	21.63	25.12	-15.92	-11.35	-8.49
270	15.90	21.00	21.00	-10.70	-9.50	-8.20	19.73	21.56	25.12	-16.04	-11.42	-8.49
280	15.15	20.70	21.10	-11.45	-9.80	-8.10	19.61	21.50	25.12	-16.16	-11.48	-8.49
290	14.35	21.10	21.20	-12.25	-9.40	-8.00	19.51	21.45	25.11	-16.26	-11.53	-8.50
300	13.85	21.10	21.00	-12.75	-9.40	-8.20	19.41	21.40	25.11	-16.36	-11.58	-8.50

TABLE A27. Comparison of human lower body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 13				SEX: Female				MODEL PREDICTIONS for SUBJECT No.: 13								
SUIT: RUKKA 8380				WATER TEMP: 31.37 deg F												
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST		
min	mean	right		BACK	mean	right		BACK								
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)				
0	29.70	32.90	36.10	34.80	0.00	0.00	0.00	0.00	32.69	32.75	33.79	0.00	0.00	0.00		
10	29.10	32.40	35.90	34.90	-0.60	-0.50	-0.20	0.10	27.46	28.04	31.22	-5.23	-4.71	-2.57		
20	29.60	31.20	35.70	34.60	-0.10	-1.70	-0.40	-0.20	25.11	26.23	30.07	-7.58	-6.52	-3.72		
30	28.50	30.90	35.30	34.10	-1.20	-2.00	-0.80	-0.70	23.15	25.54	29.91	-9.54	-7.21	-3.88		
40	27.80	32.00	35.60	33.80	-1.90	-0.90	-0.50	-1.00	21.45	25.75	30.31	-11.24	-7.00	-3.48		
50	28.50	32.30	35.50	33.60	-1.20	-0.60	-0.60	-1.20	19.94	25.99	30.51	-12.75	-6.76	-3.28		
60	27.20	31.60	35.00	33.30	-2.50	-1.30	-1.10	-1.50	18.58	26.17	30.59	-14.11	-6.58	-3.20		
70	26.15	31.10	34.90	33.10	-3.55	-1.80	-1.20	-1.70	17.38	26.33	30.63	-15.31	-6.42	-3.16		
80	25.75	31.20	34.60	32.80	-3.95	-1.70	-1.50	-2.00	16.30	26.47	30.66	-16.39	-6.28	-3.13		
90	24.80	30.60	34.60	32.40	-4.90	-2.30	-1.50	-2.40	15.32	26.59	30.67	-17.37	-6.16	-3.12		
100	24.40	30.70	34.60	32.20	-5.30	-2.20	-1.50	-2.60	14.46	26.69	30.68	-18.23	-6.06	-3.11		
110	24.05	30.50	34.70	31.90	-5.65	-2.40	-1.40	-2.90	13.68	26.76	30.68	-19.01	-5.99	-3.11		
120	23.25	29.90	34.50	31.70	-6.45	-3.00	-1.60	-3.10	13.00	26.82	30.68	-19.69	-5.93	-3.11		
130	22.35	30.40	33.70	31.50	-7.35	-2.50	-2.40	-3.30	12.40	26.87	30.69	-20.29	-5.88	-3.10		
140	22.30	29.80	33.80	31.50	-7.40	-3.10	-2.30	-3.30	11.87	26.90	30.69	-20.82	-5.85	-3.10		
150	21.35	29.20	33.70	31.50	-8.35	-3.70	-2.40	-3.30	11.41	26.93	30.70	-21.28	-5.82	-3.09		
160	21.30	28.80	34.00	31.70	-8.40	-4.10	-2.10	-3.10	11.00	26.96	30.70	-21.69	-5.79	-3.09		
170	20.90	29.00	34.20	31.70	-8.80	-3.90	-1.90	-3.10	10.65	26.97	30.71	-22.04	-5.78	-3.08		
180	20.10	28.70	34.40	31.80	-9.60	-4.20	-1.70	-3.00	10.33	26.99	30.71	-22.36	-5.76	-3.08		
190	19.90	28.50	34.30	31.80	-9.80	-4.40	-1.80	-3.00	10.06	27.00	30.72	-22.63	-5.75	-3.07		
200	20.05	28.50	35.00	31.80	-9.65	-4.40	-1.10	-3.00	9.82	27.01	30.72	-22.87	-5.74	-3.07		
210	19.95	28.50	35.20	31.80	-9.75	-4.40	-0.90	-3.00	9.61	27.02	30.73	-23.08	-5.73	-3.06		
220	19.90	28.60	34.90	31.80	-9.80	-4.30	-1.20	-3.00	9.42	27.03	30.73	-23.27	-5.72	-3.06		
230	19.20	28.20	34.60	31.70	-10.50	-4.70	-1.50	-3.10	9.26	27.04	30.73	-23.43	-5.71	-3.06		
240	19.90	29.50	34.40	31.70	-9.80	-3.40	-1.70	-3.10	9.11	27.04	30.74	-23.58	-5.71	-3.05		
250	20.45	30.80	34.30	31.80	-9.25	-2.10	-1.80	-3.00	8.99	27.05	30.74	-23.70	-5.70	-3.05		
260	19.95	30.40	34.10	31.80	-9.75	-2.50	-2.00	-3.00	8.88	27.05	30.74	-23.81	-5.70	-3.05		
270	19.50	30.70	34.10	31.80	-10.20	-2.20	-2.00	-3.00	8.78	27.06	30.74	-23.91	-5.69	-3.05		
280	19.60	30.70	34.00	31.90	-10.10	-2.20	-2.10	-2.90	8.70	27.06	30.74	-23.99	-5.69	-3.05		
290	19.15	30.10	33.90	32.00	-10.55	-2.80	-2.20	-2.80	8.62	27.06	30.75	-24.07	-5.69	-3.04		
300	19.80	29.70	34.00	31.90	-9.90	-3.20	-2.10	-2.90	8.56	27.06	30.75	-24.13	-5.69	-3.04		

TABLE A28. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 13 SEX: Female							MODEL PREDICTIONS for SUBJECT No.: 13					
SUIT: RUKKA 8380 WATER TEMP: 31.37 deg F												
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
	min	mean	right	mean	right	right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	29.90	30.80	29.70	0.00	0.00	0.00	35.76	32.98	33.61	0.00	0.00	0.00
10	29.00	30.00	28.80	-0.90	-0.80	-0.90	31.96	29.71	29.80	-3.80	-3.27	-3.81
20	28.95	28.90	27.30	-0.95	-1.90	-2.40	30.38	28.80	28.72	-5.38	-4.18	-4.89
30	28.45	28.00	26.20	-1.45	-2.80	-3.50	29.19	28.12	28.15	-6.57	-4.86	-5.46
40	27.25	27.30	25.40	-2.65	-3.50	-4.30	28.21	27.56	27.92	-7.55	-5.42	-5.69
50	27.05	26.70	24.80	-2.85	-4.10	-4.90	27.35	27.05	27.78	-8.41	-5.93	-5.83
60	26.25	26.10	24.10	-3.65	-4.70	-5.60	26.56	26.58	27.67	-9.20	-6.40	-5.94
70	25.80	25.60	23.60	-4.10	-5.20	-6.10	25.86	26.16	27.59	-9.90	-6.82	-6.02
80	24.65	25.10	23.30	-5.25	-5.70	-6.40	25.23	25.78	27.54	-10.53	-7.20	-6.07
90	24.75	24.80	23.10	-5.15	-6.00	-6.60	24.64	25.43	27.51	-11.12	-7.55	-6.10
100	24.90	24.50	22.90	-5.00	-6.30	-6.80	24.11	25.11	27.48	-11.65	-7.87	-6.13
110	24.15	24.10	22.80	-5.75	-6.70	-6.90	23.64	24.83	27.47	-12.12	-8.15	-6.14
120	24.00	23.90	22.60	-5.90	-6.90	-7.10	23.19	24.57	27.46	-12.57	-8.41	-6.15
130	22.80	23.70	22.30	-7.10	-7.10	-7.40	22.80	24.34	27.46	-12.96	-8.64	-6.15
140	21.55	23.40	22.10	-8.35	-7.40	-7.60	22.43	24.14	27.45	-13.33	-8.84	-6.16
150	20.80	23.10	21.90	-9.10	-7.70	-7.80	22.10	23.95	27.45	-13.66	-9.03	-6.16
160	20.10	22.90	21.90	-9.80	-7.90	-7.80	21.79	23.78	27.44	-13.97	-9.20	-6.17
170	19.15	22.70	22.00	-10.75	-8.10	-7.70	21.52	23.63	27.44	-14.24	-9.35	-6.17
180	18.00	22.50	22.00	-11.90	-8.30	-7.70	21.26	23.49	27.44	-14.50	-9.49	-6.17
190	17.50	22.40	22.00	-12.40	-8.40	-7.70	21.03	23.36	27.44	-14.73	-9.62	-6.17
200	17.05	22.10	21.80	-12.85	-8.70	-7.90	20.82	23.25	27.44	-14.94	-9.73	-6.17
210	16.70	21.90	21.60	-13.20	-8.90	-8.10	20.62	23.15	27.44	-15.14	-9.83	-6.17
220	16.00	21.70	21.40	-13.90	-9.10	-8.30	20.44	23.05	27.43	-15.32	-9.93	-6.18
230	15.35	21.30	21.20	-14.55	-9.50	-8.50	20.28	22.97	27.43	-15.48	-10.01	-6.18
240	14.70	21.00	21.00	-15.20	-9.80	-8.70	20.12	22.89	27.43	-15.64	-10.09	-6.18
250	14.00	20.80	21.00	-15.90	-10.00	-8.70	19.99	22.82	27.43	-15.77	-10.16	-6.18
260	13.75	20.80	21.10	-16.15	-10.00	-8.60	19.86	22.76	27.43	-15.90	-10.22	-6.18
270	13.35	20.60	21.30	-16.55	-10.20	-8.40	19.74	22.70	27.43	-16.02	-10.28	-6.18
280	13.10	20.50	21.30	-16.80	-10.30	-8.40	19.63	22.64	27.43	-16.13	-10.34	-6.18
290	12.85	20.30	21.30	-17.05	-10.50	-8.40	19.54	22.59	27.43	-16.22	-10.39	-6.18
300	12.65	20.10	21.30	-17.25	-10.70	-8.40	19.44	22.55	27.43	-16.32	-10.43	-6.18

TABLE A29. Comparison of human lower body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 15 SEX: Female									MODEL PREDICTIONS for SUBJECT No.: 15					
SUIT: RUKKA 8380 WATER TEMP: 31.37 deg F														
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST
min	mean	right		BACK	mean	right		BACK						
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)		
0	33.50	32.20	34.80	33.90	0.00	0.00	0.00	0.00	32.69	32.75	33.79	0.00	0.00	0.00
10	32.70	31.30	34.30	33.20	-0.80	-0.90	-0.50	-0.70	27.46	27.71	30.70	-5.23	-5.04	-3.09
20	31.60	30.70	34.20	32.90	-1.90	-1.50	-0.60	-1.00	25.11	25.80	29.37	-7.58	-6.95	-4.42
30	30.60	30.00	34.10	33.00	-2.90	-2.20	-0.70	-0.90	23.16	25.10	29.23	-9.53	-7.65	-4.56
40	29.35	29.50	33.80	33.00	-4.15	-2.70	-1.00	-0.90	21.47	24.96	29.39	-11.22	-7.79	-4.40
50	27.55	29.00	33.10	32.90	-5.95	-3.20	-1.70	-1.00	19.98	24.94	29.51	-12.71	-7.81	-4.28
60	26.15	28.00	32.60	32.80	-7.35	-4.20	-2.20	-1.10	18.63	24.98	29.59	-14.06	-7.77	-4.20
70	25.50	27.30	31.90	32.90	-8.00	-4.90	-2.90	-1.00	17.43	25.03	29.63	-15.26	-7.72	-4.16
80	24.45	26.90	31.60	32.80	-9.05	-5.30	-3.20	-1.10	16.36	25.09	29.66	-16.33	-7.66	-4.13
90	23.35	26.50	31.40	32.80	-10.15	-5.70	-3.40	-1.10	15.38	25.17	29.69	-17.31	-7.58	-4.10
100	22.55	26.30	31.40	32.80	-10.95	-5.90	-3.40	-1.10	14.52	25.25	29.70	-18.17	-7.50	-4.09
110	21.60	25.70	31.20	32.80	-11.90	-6.50	-3.60	-1.10	13.75	25.32	29.71	-18.94	-7.43	-4.08
120	21.20	26.00	31.40	32.90	-12.30	-6.20	-3.40	-1.00	13.07	25.38	29.72	-19.62	-7.37	-4.07
130	20.60	24.90	31.80	33.00	-12.90	-7.30	-3.00	-0.90	12.48	25.43	29.73	-20.21	-7.32	-4.06
140	20.10	25.10	32.30	33.10	-13.40	-7.10	-2.50	-0.80	11.96	25.48	29.73	-20.73	-7.27	-4.06
150	19.95	25.10	32.60	33.10	-13.55	-7.10	-2.20	-0.80	11.50	25.51	29.74	-21.19	-7.24	-4.05
160	20.25	24.90	32.70	33.00	-13.25	-7.30	-2.10	-0.90	11.10	25.54	29.74	-21.59	-7.21	-4.05
170	20.15	24.70	32.70	33.00	-13.35	-7.50	-2.10	-0.90	10.75	25.56	29.74	-21.94	-7.19	-4.05
180	20.05	25.00	32.70	33.00	-13.45	-7.20	-2.10	-0.90	10.43	25.58	29.75	-22.26	-7.17	-4.04
190	19.70	24.40	32.30	32.80	-13.80	-7.80	-2.50	-1.10	10.16	25.60	29.75	-22.53	-7.15	-4.04
200	20.20	25.00	32.20	32.90	-13.30	-7.20	-2.60	-1.00	9.92	25.61	29.75	-22.77	-7.14	-4.04
210	20.50	25.50	32.30	32.80	-13.00	-6.70	-2.50	-1.10	9.71	25.62	29.76	-22.98	-7.13	-4.03
220	20.90	25.90	32.30	32.80	-12.60	-6.30	-2.50	-1.10	9.52	25.63	29.76	-23.17	-7.12	-4.03
230	20.95	26.60	32.00	32.70	-12.55	-5.60	-2.80	-1.20	9.36	25.64	29.76	-23.33	-7.11	-4.03
240	20.80	26.00	32.30	32.70	-12.70	-6.20	-2.50	-1.20	9.22	25.65	29.77	-23.47	-7.10	-4.02
250	20.30	26.00	32.00	32.60	-13.20	-6.20	-2.80	-1.30	9.09	25.65	29.77	-23.60	-7.10	-4.02
260	20.45	25.70	31.90	32.70	-13.05	-6.50	-2.90	-1.20	8.98	25.66	29.77	-23.71	-7.09	-4.02
270	20.85	26.10	32.30	32.80	-12.65	-6.10	-2.50	-1.10	8.88	25.66	29.77	-23.81	-7.09	-4.02
280	21.10	26.30	32.50	32.90	-12.40	-5.90	-2.30	-1.00	8.80	25.67	29.77	-23.89	-7.08	-4.02
290	21.45	26.50	32.50	32.90	-12.05	-5.70	-2.30	-1.00	8.73	25.67	29.77	-23.96	-7.08	-4.02
300	21.50	26.60	32.20	32.90	-12.00	-5.60	-2.60	-1.00	8.66	25.67	29.77	-24.03	-7.08	-4.02

TABLE A30. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 15 SEX: Female							MODEL PREDICTIONS for SUBJECT No.: 15					
SUIT: RUKKA 8380 WATER TEMP: 31.37 deg F												
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
min	mean		right	mean		right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.15	26.50	26.50	0.00	0.00	0.00	35.77	32.98	33.61	0.00	0.00	0.00
10	31.10	24.90	24.30	-1.05	-1.60	-2.20	31.97	29.12	29.26	-3.80	-3.86	-4.35
20	30.30	23.90	22.80	-1.85	-2.60	-3.70	30.39	28.05	27.87	-5.38	-4.93	-5.74
30	29.50	23.00	21.80	-2.65	-3.50	-4.70	29.22	27.33	27.10	-6.55	-5.65	-6.51
40	28.85	22.20	21.00	-3.30	-4.30	-5.50	28.24	26.75	26.67	-7.53	-6.23	-6.94
50	27.60	20.90	20.40	-4.55	-5.60	-6.10	27.39	26.23	26.37	-8.38	-6.75	-7.24
60	26.80	20.30	20.00	-5.35	-6.20	-6.50	26.61	25.77	26.16	-9.16	-7.21	-7.45
70	25.90	19.30	19.60	-6.25	-7.20	-6.90	25.91	25.34	26.01	-9.86	-7.64	-7.60
80	25.15	18.70	19.30	-7.00	-7.80	-7.20	25.28	24.95	25.89	-10.49	-8.03	-7.72
90	24.15	18.60	19.10	-8.00	-7.90	-7.40	24.70	24.60	25.79	-11.07	-8.38	-7.82
100	23.60	18.00	18.90	-8.55	-8.50	-7.60	24.18	24.27	25.73	-11.59	-8.71	-7.88
110	22.90	17.60	18.90	-9.25	-8.90	-7.60	23.70	23.98	25.68	-12.07	-9.00	-7.93
120	22.55	17.30	18.80	-9.60	-9.20	-7.70	23.26	23.71	25.64	-12.51	-9.27	-7.97
130	22.00	17.00	18.70	-10.15	-9.50	-7.80	22.86	23.47	25.61	-12.91	-9.51	-8.00
140	21.40	17.00	18.80	-10.75	-9.50	-7.70	22.50	23.25	25.58	-13.27	-9.73	-8.03
150	20.90	16.60	18.70	-11.25	-9.90	-7.80	22.16	23.05	25.57	-13.61	-9.93	-8.04
160	20.30	16.20	18.60	-11.85	-10.30	-7.90	21.85	22.86	25.55	-13.92	-10.12	-8.06
170	19.75	16.00	18.70	-12.40	-10.50	-7.80	21.57	22.70	25.54	-14.20	-10.28	-8.07
180	19.20	16.00	18.80	-12.95	-10.50	-7.70	21.31	22.55	25.53	-14.46	-10.43	-8.08
190	18.75	15.80	18.90	-13.40	-10.70	-7.60	21.08	22.41	25.52	-14.69	-10.57	-8.09
200	18.45	15.50	18.90	-13.70	-11.00	-7.60	20.86	22.29	25.52	-14.91	-10.69	-8.09
210	18.05	15.20	18.80	-14.10	-11.30	-7.70	20.66	22.18	25.51	-15.11	-10.80	-8.10
220	17.90	15.20	18.70	-14.25	-11.30	-7.80	20.48	22.08	25.51	-15.29	-10.90	-8.10
230	17.85	15.00	18.60	-14.30	-11.50	-7.90	20.31	21.98	25.50	-15.46	-11.00	-8.11
240	17.70	15.10	18.60	-14.45	-11.40	-7.90	20.15	21.90	25.50	-15.62	-11.08	-8.11
250	17.20	15.00	18.60	-14.95	-11.50	-7.90	20.01	21.82	25.49	-15.76	-11.16	-8.12
260	16.70	14.80	18.80	-15.45	-11.70	-7.70	19.88	21.75	25.49	-15.89	-11.23	-8.12
270	16.45	14.70	19.40	-15.70	-11.80	-7.10	19.76	21.68	25.49	-16.01	-11.30	-8.12
280	16.20	14.60	19.80	-15.95	-11.90	-6.70	19.65	21.62	25.49	-16.12	-11.36	-8.12
290	16.00	14.40	20.00	-16.15	-12.10	-6.50	19.54	21.57	25.48	-16.23	-11.41	-8.13
300	15.90	14.10	19.90	-16.25	-12.40	-6.60	19.45	21.52	25.48	-16.32	-11.46	-8.13

TABLE A31. Comparison of human lower body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-f: female subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 12				SEX: Male				MODEL PREDICTIONS for SUBJECT No.: 12							
SUIT: URSUIT 5001				WATER TEMP: 31.37 deg F											
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST	
min	mean	right		BACK	mean	right		BACK							
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)			
0	33.90	35.40	34.40	33.80	0.00	0.00	0.00	0.00	32.71	32.75	33.79	0.00	0.00	0.00	
10	33.55	34.70	34.00	32.40	-0.35	-0.70	-0.40	-1.40	27.53	28.12	31.05	-5.18	-4.63	-2.74	
20	32.80	34.20	33.40	31.30	-1.10	-1.20	-1.00	-2.50	25.34	26.40	30.09	-7.37	-6.35	-3.70	
30	31.80	31.80	32.60	31.70	-2.10	-3.60	-1.80	-2.10	23.52	25.50	29.73	-9.19	-7.25	-4.06	
40	30.70	30.50	31.70	31.40	-3.20	-4.90	-2.70	-2.40	21.93	25.42	30.02	-10.78	-7.33	-3.77	
50	30.05	30.80	31.20	31.10	-3.85	-4.60	-3.20	-2.70	20.50	25.63	30.32	-12.21	-7.12	-3.47	
60	29.30	30.80	30.70	30.50	-4.60	-4.60	-3.70	-3.30	19.19	25.86	30.48	-13.52	-6.89	-3.31	
70	28.35	30.30	30.10	30.00	-5.55	-5.10	-4.30	-3.80	18.03	26.04	30.55	-14.68	-6.71	-3.24	
80	27.55	29.90	30.10	29.60	-6.35	-5.50	-4.30	-4.20	16.98	26.22	30.57	-15.73	-6.53	-3.22	
90	26.55	29.40	30.20	29.30	-7.35	-6.00	-4.20	-4.50	16.04	26.35	30.57	-16.67	-6.40	-3.22	
100	25.45	28.80	30.10	26.90	-8.45	-6.60	-4.30	-6.90	15.20	26.45	30.55	-17.51	-6.30	-3.24	
110	24.70	28.40	30.10	28.80	-9.20	-7.00	-4.30	-5.00	14.46	26.53	30.53	-18.25	-6.22	-3.26	
120	24.10	27.80	30.10	28.70	-9.80	-7.60	-4.30	-5.10	13.79	26.60	30.50	-18.92	-6.15	-3.29	
130	23.30	27.50	30.10	28.80	-10.60	-7.90	-4.30	-5.00	13.19	26.66	30.48	-19.52	-6.09	-3.31	
140	22.60	27.60	30.00	28.90	-11.30	-7.80	-4.40	-4.90	12.66	26.72	30.47	-20.05	-6.03	-3.32	
150	21.80	27.10	30.30	23.70	-12.10	-8.30	-4.10	-10.10	12.18	26.76	30.45	-20.53	-5.99	-3.34	
160	21.40	27.30	30.70	28.60	-12.50	-8.10	-3.70	-5.20	11.76	26.79	30.44	-20.95	-5.96	-3.35	
170	20.35	27.50	31.00	28.70	-13.05	-7.90	-3.40	-5.10	11.38	26.79	30.42	-21.33	-5.96	-3.37	
180	20.20	27.40	31.00	28.70	-13.70	-8.00	-3.40	-5.10	11.04	26.82	30.41	-21.67	-5.93	-3.38	
190	19.75	27.10	31.10	28.60	-14.15	-8.30	-3.30	-5.20	10.73	26.85	30.40	-21.98	-5.90	-3.39	
200	19.20	26.90	31.30	28.80	-14.70	-8.50	-3.10	-5.00	10.46	26.87	30.40	-22.25	-5.88	-3.39	
210	18.75	26.70	31.20	29.00	-15.15	-8.70	-3.20	-4.80	10.22	26.88	30.39	-22.49	-5.87	-3.40	
220	18.30	26.70	31.60	28.90	-15.60	-8.70	-2.80	-4.90	10.01	26.89	30.38	-22.70	-5.86	-3.41	
230	18.05	26.30	31.20	28.80	-15.85	-9.10	-3.20	-5.00	9.81	26.90	30.38	-22.90	-5.85	-3.41	
240	17.50	26.30	31.00	28.70	-16.40	-9.10	-3.40	-5.10	9.64	26.90	30.38	-23.07	-5.85	-3.41	
250	17.50	26.30	31.00	28.70	-16.40	-9.10	-3.40	-5.10	9.49	26.91	30.37	-23.22	-5.84	-3.42	
260	17.15	26.00	30.70	28.70	-16.75	-9.40	-3.70	-5.10	9.35	26.91	30.37	-23.36	-5.84	-3.42	
270	16.90	26.10	31.00	28.80	-17.00	-9.30	-3.40	-5.00	9.23	26.92	30.37	-23.48	-5.83	-3.42	
280	16.65	25.80	30.90	28.80	-17.25	-9.60	-3.50	-5.00	9.12	26.92	30.36	-23.59	-5.83	-3.43	
290	16.55	25.80	30.70	28.90	-17.35	-9.60	-3.70	-4.90	9.02	26.92	30.36	-23.69	-5.83	-3.43	
300	16.25	25.90	30.90	28.90	-17.65	-9.50	-3.50	-4.90	8.93	26.92	30.36	-23.78	-5.83	-3.43	
310	16.10	26.00	30.90	29.00	-17.80	-9.40	-3.50	-4.80	8.85	26.93	30.36	-23.86	-5.82	-3.43	
320	15.70	25.90	31.00	29.30	-18.20	-9.50	-3.40	-4.50	8.79	26.93	30.35	-23.92	-5.82	-3.44	
330	15.75	26.30	30.70	29.00	-18.15	-9.10	-3.70	-4.80	8.72	26.93	30.35	-23.99	-5.82	-3.44	

TABLE A32. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 12 SEX: Male							MODEL PREDICTIONS for SUBJECT No.: 12					
SUIT: URSUIT 5001 WATER TEMP: 31.37 deg F												
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
min	mean		right	mean		right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	31.05	31.60	31.90	0.00	0.00	0.00	35.78	32.98	33.61	0.00	0.00	0.00
10	30.25	28.20	28.70	-0.80	-3.40	-3.20	31.99	30.09	30.16	-3.79	-2.89	-3.45
20	29.45	26.50	27.00	-1.60	-5.10	-4.90	30.43	29.28	29.20	-5.35	-3.70	-4.41
30	28.65	25.00	25.70	-2.40	-6.60	-6.20	29.24	28.62	28.64	-6.54	-4.36	-4.97
40	27.85	24.00	24.70	-3.20	-7.60	-7.20	28.26	28.08	28.35	-7.52	-4.90	-5.26
50	27.55	22.90	23.70	-3.50	-8.70	-8.20	27.40	27.58	28.18	-8.38	-5.40	-5.43
60	27.05	22.10	23.10	-4.00	-9.50	-8.80	26.62	27.11	28.04	-9.16	-5.87	-5.57
70	26.90	21.50	22.30	-4.15	-10.10	-9.60	25.91	26.68	27.94	-9.87	-6.30	-5.67
80	26.25	20.90	21.80	-4.80	-10.70	-10.10	25.25	26.27	27.85	-10.53	-6.71	-5.76
90	25.65	20.50	21.40	-5.40	-11.10	-10.50	24.64	25.88	27.78	-11.14	-7.10	-5.83
100	25.35	20.00	20.90	-5.70	-11.60	-11.00	24.08	25.53	27.72	-11.70	-7.45	-5.89
110	24.90	19.70	20.60	-6.15	-11.90	-11.30	23.56	25.20	27.66	-12.22	-7.78	-5.95
120	24.65	19.40	20.20	-6.40	-12.20	-11.70	23.07	24.89	27.62	-12.71	-8.09	-5.99
130	23.95	19.20	20.10	-7.10	-12.40	-11.80	22.62	24.61	27.59	-13.16	-8.37	-6.02
140	23.50	19.10	19.80	-7.55	-12.50	-12.10	22.21	24.35	27.57	-13.57	-8.63	-6.04
150	23.40	18.80	19.50	-7.65	-12.80	-12.40	21.82	24.12	27.55	-13.96	-8.86	-6.06
160	23.20	18.60	19.40	-7.85	-13.00	-12.50	21.47	23.90	27.53	-14.31	-9.08	-6.08
170	22.75	18.30	19.10	-8.30	-13.30	-12.80	21.14	23.70	27.51	-14.64	-9.28	-6.10
180	22.50	18.00	19.00	-8.55	-13.60	-12.90	20.83	23.52	27.50	-14.95	-9.46	-6.11
190	22.10	17.10	19.00	-8.95	-14.50	-12.90	20.55	23.35	27.49	-15.23	-9.63	-6.12
200	21.45	17.60	18.90	-9.60	-14.00	-13.00	20.29	23.20	27.48	-15.49	-9.78	-6.13
210	20.90	17.30	19.20	-10.15	-14.30	-12.70	20.04	23.06	27.47	-15.74	-9.92	-6.14
220	20.65	17.20	19.40	-10.40	-14.40	-12.50	19.82	22.93	27.46	-15.96	-10.05	-6.15
230	20.00	17.20	19.90	-11.05	-14.40	-12.00	19.61	22.82	27.45	-16.17	-10.16	-6.16
240	19.75	17.20	20.50	-11.30	-14.40	-11.40	19.42	22.71	27.45	-16.36	-10.27	-6.16
250	19.45	17.50	20.30	-11.60	-14.10	-11.60	19.24	22.61	27.44	-16.54	-10.37	-6.17
260	19.10	17.70	21.10	-11.95	-13.90	-10.80	19.08	22.52	27.44	-16.70	-10.46	-6.17
270	18.80	17.70	21.30	-12.25	-13.90	-10.60	18.92	22.43	27.43	-16.86	-10.55	-6.18
280	18.35	17.80	21.50	-12.70	-13.80	-10.40	18.78	22.35	27.43	-17.00	-10.63	-6.18
290	18.00	17.70	21.70	-13.05	-13.90	-10.20	18.65	22.28	27.42	-17.13	-10.70	-6.19
300	17.65	17.50	21.60	-13.40	-14.10	-10.30	18.53	22.22	27.42	-17.25	-10.76	-6.19
310	17.35	17.40	21.90	-13.70	-14.20	-10.00	18.42	22.16	27.41	-17.36	-10.82	-6.20
320	16.95	17.30	22.00	-14.10	-14.30	-9.90	18.31	22.10	27.41	-17.47	-10.88	-6.20
330	16.50	17.40	22.00	-14.55	-14.20	-9.90	18.21	22.05	27.40	-17.57	-10.93	-6.21

TABLE A33. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 16				SEX: Male				MODEL PREDICTIONS for SUBJECT No.: 16							
SUIT: URSUIT 5001				WATER TEMP: 31.37 deg F											
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST	
min	mean	right		BACK	mean	right		BACK							
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)			
0	27.80	33.30	35.60	35.50	0.00	0.00	0.00	0.00	32.71	32.75	33.79	0.00	0.00	0.00	
10	27.65	31.80	34.50	34.80	-0.15	-1.50	-1.10	-0.70	27.52	27.98	30.83	-5.19	-4.77	-2.96	
20	27.20	31.40	33.60	34.60	-0.60	-1.90	-2.00	-0.90	25.33	26.25	29.83	-7.38	-6.50	-3.96	
30	26.60	31.10	33.20	34.50	-1.20	-2.20	-2.40	-1.00	23.53	25.39	29.53	-9.18	-7.36	-4.26	
40	26.00	30.60	33.10	34.20	-1.80	-2.70	-2.50	-1.30	21.96	25.28	29.79	-10.75	-7.47	-4.00	
50	25.25	30.30	32.70	33.80	-2.55	-3.00	-2.90	-1.70	20.55	25.33	29.99	-12.16	-7.42	-3.80	
60	24.20	29.50	32.50	33.20	-3.60	-3.80	-3.10	-2.30	19.25	25.44	30.12	-13.46	-7.31	-3.67	
70	23.45	29.00	32.60	32.70	-4.35	-4.30	-3.00	-2.80	18.10	25.58	30.19	-14.61	-7.17	-3.60	
80	23.00	28.90	31.90	32.30	-4.80	-4.40	-3.70	-3.20	17.06	25.71	30.22	-15.65	-7.04	-3.57	
90	22.10	28.50	32.00	31.80	-5.70	-4.80	-3.60	-3.70	16.13	25.83	30.23	-16.58	-6.92	-3.56	
100	21.55	28.00	31.80	31.30	-6.25	-5.30	-3.80	-4.20	15.30	25.94	30.21	-17.41	-6.81	-3.58	
110	20.85	27.80	31.70	30.70	-6.95	-5.50	-3.90	-4.80	14.56	26.02	30.19	-18.15	-6.73	-3.60	
120	20.20	27.00	31.90	30.30	-7.60	-6.30	-3.70	-5.20	13.89	26.10	30.17	-18.82	-6.65	-3.62	
130	19.00	26.00	31.20	29.90	-8.80	-7.30	-4.40	-5.60	13.29	26.16	30.15	-19.42	-6.59	-3.64	
140	18.50	25.60	30.70	29.60	-9.30	-7.70	-4.90	-5.90	12.76	26.22	30.14	-19.95	-6.53	-3.65	
150	17.85	24.80	30.90	29.20	-9.95	-8.50	-4.70	-6.30	12.28	26.26	30.12	-20.43	-6.49	-3.67	
160	16.35	24.50	30.50	29.00	-11.45	-8.80	-5.10	-6.50	11.86	26.30	30.11	-20.85	-6.45	-3.68	
170	16.35	25.50	30.40	29.00	-11.45	-7.80	-5.20	-6.50	11.48	26.33	30.09	-21.23	-6.42	-3.70	
180	16.45	26.30	31.20	29.00	-11.35	-7.00	-4.40	-6.50	11.13	26.35	30.08	-21.58	-6.40	-3.71	
190	15.75	25.70	30.80	28.80	-12.05	-7.60	-4.80	-6.70	10.83	26.37	30.07	-21.88	-6.38	-3.72	
200	15.35	25.40	30.40	28.70	-12.45	-7.90	-5.20	-6.80	10.56	26.39	30.06	-22.15	-6.36	-3.73	
210	14.95	24.70	30.40	28.50	-12.85	-8.60	-5.20	-7.00	10.31	26.40	30.06	-22.40	-6.35	-3.73	
220	14.35	24.60	30.30	28.20	-13.45	-8.70	-5.30	-7.30	10.09	26.41	30.05	-22.62	-6.34	-3.74	
230	13.80	24.10	30.60	28.10	-14.00	-9.20	-5.00	-7.40	9.90	26.42	30.04	-22.81	-6.33	-3.75	
240	13.30	24.20	30.10	28.10	-14.50	-9.10	-5.50	-7.40	9.72	26.43	30.04	-22.99	-6.32	-3.75	
250	13.00	23.80	30.20	27.90	-14.80	-9.50	-5.40	-7.60	9.56	26.43	30.04	-23.15	-6.32	-3.75	
260	12.70	23.40	30.40	27.80	-15.10	-9.90	-5.20	-7.70	9.43	26.44	30.03	-23.28	-6.31	-3.76	
270	12.80	23.50	31.10	27.60	-15.00	-9.80	-4.50	-7.90	9.30	26.44	30.03	-23.41	-6.31	-3.76	
280	12.90	23.60	31.00	27.50	-14.90	-9.70	-4.60	-8.00	9.19	26.45	30.02	-23.52	-6.30	-3.77	
290	12.95	23.10	31.60	27.20	-14.85	-10.20	-4.00	-8.30	9.09	26.45	30.02	-23.62	-6.30	-3.77	
300	12.90	22.90	31.30	27.00	-14.90	-10.40	-4.30	-8.50	9.00	26.45	30.02	-23.71	-6.30	-3.77	

TABLE A34. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 16 SEX: Male							MODEL PREDICTIONS for SUBJECT No.: 16					
SUIT: URSUIT 5001 WATER TEMP: 31.37 deg F												
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
min	mean		right	mean		right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	25.75	28.80	30.00	0.00	0.00	0.00	35.78	32.98	33.61	0.00	0.00	0.00
10	24.85	26.50	27.90	-0.90	-2.30	-2.10	31.98	29.81	29.88	-3.80	-3.17	-3.73
20	24.30	25.50	26.70	-1.45	-3.30	-3.30	30.42	28.98	28.87	-5.36	-4.00	-4.74
30	23.80	24.70	25.30	-1.95	-4.10	-4.70	29.24	28.33	28.28	-6.54	-4.65	-5.33
40	23.20	24.00	24.10	-2.55	-4.80	-5.90	28.26	27.79	27.97	-7.52	-5.19	-5.64
50	22.70	23.30	23.40	-3.05	-5.50	-6.60	27.40	27.30	27.74	-8.38	-5.68	-5.87
60	22.10	22.70	22.70	-3.65	-6.10	-7.30	26.62	26.83	27.57	-9.16	-6.15	-6.04
70	21.55	22.40	22.40	-4.20	-6.40	-7.60	25.91	26.40	27.44	-9.87	-6.58	-6.17
80	21.05	22.00	22.10	-4.70	-6.80	-7.90	25.26	25.99	27.33	-10.52	-6.99	-6.28
90	20.55	21.70	21.70	-5.20	-7.10	-8.30	24.65	25.61	27.24	-11.13	-7.37	-6.37
100	19.90	21.80	21.70	-5.85	-7.00	-8.30	24.09	25.25	27.17	-11.69	-7.73	-6.44
110	19.65	22.10	21.60	-6.10	-6.70	-8.40	23.57	24.92	27.11	-12.21	-8.06	-6.50
120	19.25	22.40	21.40	-6.50	-6.40	-8.60	23.08	24.61	27.06	-12.70	-8.37	-6.55
130	18.55	22.30	21.40	-7.20	-6.50	-8.60	22.63	24.33	27.02	-13.15	-8.65	-6.59
140	17.90	22.20	21.50	-7.85	-6.60	-8.50	22.22	24.07	26.99	-13.56	-8.91	-6.62
150	17.45	22.00	21.40	-8.30	-6.80	-8.60	21.83	23.82	26.96	-13.95	-9.16	-6.65
160	16.95	21.50	21.30	-8.80	-7.30	-8.70	21.47	23.60	26.94	-14.31	-9.38	-6.67
170	16.60	21.20	21.10	-9.15	-7.60	-8.90	21.14	23.40	26.92	-14.64	-9.58	-6.69
180	16.45	20.90	21.00	-9.30	-7.90	-9.00	20.83	23.21	26.90	-14.95	-9.77	-6.71
190	16.15	20.80	21.00	-9.60	-8.00	-9.00	20.55	23.04	26.89	-15.23	-9.94	-6.72
200	15.60	20.70	20.90	-10.15	-8.10	-9.10	20.28	22.88	26.87	-15.50	-10.10	-6.74
210	15.20	20.50	20.70	-10.55	-8.30	-9.30	20.03	22.74	26.86	-15.75	-10.24	-6.75
220	14.90	20.40	20.60	-10.85	-8.40	-9.40	19.81	22.61	26.85	-15.97	-10.37	-6.76
230	14.70	20.20	20.50	-11.05	-8.60	-9.50	19.60	22.48	26.84	-16.18	-10.50	-6.77
240	14.35	19.70	20.70	-11.40	-9.10	-9.30	19.40	22.37	26.84	-16.38	-10.61	-6.77
250	14.15	19.30	20.60	-11.60	-9.50	-9.40	19.22	22.27	26.83	-16.56	-10.71	-6.78
260	13.65	19.00	20.70	-12.10	-9.80	-9.30	19.05	22.17	26.82	-16.73	-10.81	-6.79
270	13.50	18.80	20.70	-12.25	-10.00	-9.30	18.89	22.08	26.81	-16.89	-10.90	-6.80
280	13.20	18.50	20.50	-12.55	-10.30	-9.50	18.75	22.00	26.81	-17.03	-10.98	-6.80
290	12.85	18.10	20.20	-12.90	-10.70	-9.80	18.61	21.93	26.80	-17.17	-11.05	-6.81
300	12.50	18.20	20.60	-13.25	-10.60	-9.40	18.48	21.86	26.80	-17.30	-11.12	-6.81

TABLE A35. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 10				SEX: Male		MODEL PREDICTIONS for SUBJECT No.: 10									
SUIT: RUKKA 8380				WATER TEMP: 31.37 deg F											
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST	
min	mean	right		BACK	mean	right		BACK							
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)			
0	32.55	33.70	34.90	34.80	0.00	0.00	0.00	0.00	32.70	32.76	33.80	0.00	0.00	0.00	
10	31.10	32.60	34.80	35.10	-1.45	-1.10	-0.10	0.30	27.48	28.82	32.07	-5.22	-3.94	-1.73	
20	27.65	32.00	34.70	34.80	-4.90	-1.70	-0.20	0.00	25.25	27.15	31.28	-7.45	-5.61	-2.52	
30	26.50	31.50	34.70	34.80	-6.05	-2.20	-0.20	0.00	23.33	25.97	30.62	-9.37	-6.79	-3.18	
40	25.50	31.10	34.70	35.10	-7.05	-2.60	-0.20	0.30	21.67	25.93	30.93	-11.03	-6.83	-2.87	
50	24.65	30.60	34.60	34.90	-7.90	-3.10	-0.30	0.10	20.17	26.63	31.50	-12.53	-6.13	-2.30	
60	24.30	30.60	34.00	34.70	-8.25	-3.10	-0.90	-0.10	18.82	27.48	31.87	-13.88	-5.28	-1.93	
70	23.30	30.60	33.80	34.40	-9.25	-3.10	-1.10	-0.40	17.62	28.07	31.99	-15.08	-4.69	-1.81	
80	22.20	30.80	33.80	34.10	-10.35	-2.90	-1.10	-0.70	16.54	28.42	32.01	-16.16	-4.34	-1.79	
90	21.40	31.60	34.10	33.80	-11.15	-2.10	-0.80	-1.00	15.55	28.60	31.99	-17.15	-4.16	-1.81	
100	21.50	32.10	34.30	33.50	-11.05	-1.60	-0.60	-1.30	14.68	28.71	31.97	-18.02	-4.05	-1.83	
110	21.30	31.80	34.30	33.30	-11.25	-1.90	-0.60	-1.50	13.91	28.78	31.95	-18.79	-3.98	-1.85	
120	20.90	31.10	34.30	33.20	-11.65	-2.60	-0.60	-1.60	13.22	28.84	31.94	-19.48	-3.92	-1.86	
130	20.15	30.20	34.20	33.10	-12.40	-3.50	-0.70	-1.70	12.62	28.88	31.93	-20.08	-3.88	-1.87	
140	20.85	29.80	34.30	33.10	-11.70	-3.90	-0.60	-1.70	12.09	28.91	31.92	-20.61	-3.85	-1.88	
150	20.60	29.20	34.40	33.00	-11.95	-4.50	-0.50	-1.80	11.61	28.93	31.92	-21.09	-3.83	-1.88	
160	19.60	29.70	34.30	32.90	-12.95	-4.00	-0.60	-1.90	11.20	28.95	31.91	-21.50	-3.81	-1.89	
170	20.50	30.80	34.60	32.80	-12.05	-2.90	-0.30	-2.00	10.83	28.97	31.91	-21.87	-3.79	-1.89	
180	19.75	31.40	34.50	32.70	-12.80	-2.30	-0.40	-2.10	10.50	28.98	31.91	-22.20	-3.78	-1.89	
190	19.70	30.80	34.20	32.70	-12.85	-2.90	-0.70	-2.10	10.21	28.99	31.91	-22.49	-3.77	-1.89	
200	19.50	30.80	34.30	32.70	-13.05	-2.90	-0.60	-2.10	9.96	29.00	31.91	-22.74	-3.76	-1.89	
210	20.10	30.30	34.50	32.80	-12.45	-3.40	-0.40	-2.00	9.73	29.01	31.92	-22.97	-3.75	-1.88	
220	19.50	30.20	34.40	32.90	-13.05	-3.50	-0.50	-1.90	9.53	29.01	31.92	-23.17	-3.75	-1.88	
230	20.30	29.80	34.60	32.90	-12.25	-3.90	-0.30	-1.90	9.36	29.02	31.92	-23.34	-3.74	-1.88	
240	20.65	29.40	34.50	33.00	-11.90	-4.30	-0.40	-1.80	9.20	29.03	31.92	-23.50	-3.73	-1.88	
250	20.55	29.00	34.30	33.20	-12.00	-4.70	-0.60	-1.60	9.06	29.03	31.92	-23.64	-3.73	-1.88	
260	21.05	30.00	34.70	33.40	-11.50	-3.70	-0.20	-1.40	8.94	29.03	31.92	-23.76	-3.73	-1.88	
270	22.00	31.70	34.70	33.30	-10.55	-2.00	-0.20	-1.50	8.83	29.04	31.92	-23.87	-3.72	-1.88	
280	21.75	31.50	34.60	33.30	-10.80	-2.20	-0.30	-1.50	8.74	29.04	31.92	-23.96	-3.72	-1.88	
290	21.50	30.90	34.60	33.10	-11.05	-2.80	-0.30	-1.70	8.65	29.04	31.92	-24.05	-3.72	-1.88	
300	21.85	30.30	34.20	32.80	-10.70	-3.40	-0.70	-2.00	8.58	29.05	31.92	-24.12	-3.71	-1.88	
310	21.40	30.30	34.40	32.90	-11.15	-3.40	-0.50	-1.90	8.51	29.05	31.92	-24.19	-3.71	-1.88	
320	21.45	30.10	34.30	32.80	-11.10	-3.60	-0.60	-2.00	8.46	29.05	31.92	-24.24	-3.71	-1.88	
330	21.05	28.70	34.00	32.60	-11.50	-5.00	-0.90	-2.20	8.41	29.05	31.92	-24.29	-3.71	-1.88	
340	20.45	28.10	33.60	32.10	-12.10	-5.60	-1.30	-2.70	8.36	29.05	31.92	-24.34	-3.71	-1.88	
350	20.05	29.00	33.70	31.70	-12.50	-4.70	-1.20	-3.10	8.32	29.05	31.92	-24.38	-3.71	-1.88	
360	20.45	29.10	33.60	31.50	-12.10	-4.60	-1.30	-3.30	8.29	29.05	31.92	-24.41	-3.71	-1.88	

TABLE A36. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 10			SEX: Male				MODEL PREDICTIONS for SUBJECT No.: 10					
SUIT: RUKKA 8380			WATER TEMP: 31.37 deg F									
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
min	mean		right	mean		right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	28.70	33.40	33.70	0.00	0.00	0.00	35.77	33.00	33.63	0.00	0.00	0.00
10	27.30	31.40	31.60	-1.40	-2.00	-2.10	31.96	30.76	31.43	-3.81	-2.24	-2.20
20	26.35	30.00	30.40	-2.35	-3.40	-3.30	30.41	29.95	30.53	-5.36	-3.05	-3.10
30	25.00	29.10	29.60	-3.70	-4.30	-4.10	29.18	29.30	29.95	-6.59	-3.70	-3.68
40	24.00	28.20	29.00	-4.70	-5.20	-4.70	28.18	28.77	29.74	-7.59	-4.23	-3.89
50	23.75	27.40	28.60	-4.95	-6.00	-5.10	27.30	28.28	29.73	-8.47	-4.72	-3.90
60	22.00	26.20	28.20	-6.70	-7.20	-5.50	26.51	27.82	29.79	-9.26	-5.18	-3.84
70	21.25	25.90	28.40	-7.45	-7.50	-5.30	25.80	27.40	29.84	-9.97	-5.60	-3.79
80	21.05	25.60	28.50	-7.65	-7.80	-5.20	25.15	27.02	29.87	-10.62	-5.98	-3.76
90	20.75	25.50	28.40	-7.95	-7.90	-5.30	24.54	26.66	29.87	-11.23	-6.34	-3.76
100	20.05	25.20	28.10	-8.65	-8.20	-5.60	23.99	26.33	29.86	-11.78	-6.67	-3.77
110	19.90	25.00	27.90	-8.80	-8.40	-5.80	23.48	26.04	29.86	-12.29	-6.96	-3.77
120	19.35	25.00	27.90	-9.35	-8.40	-5.80	23.02	25.76	29.86	-12.75	-7.24	-3.77
130	18.90	24.90	27.80	-9.80	-8.50	-5.90	22.59	25.52	29.86	-13.18	-7.48	-3.77
140	18.60	24.90	27.80	-10.10	-8.50	-5.90	22.21	25.30	29.86	-13.56	-7.70	-3.77
150	19.25	24.80	27.50	-9.45	-8.60	-6.20	21.85	25.10	29.86	-13.92	-7.90	-3.77
160	22.05	25.00	27.20	-6.65	-8.40	-6.50	21.52	24.93	29.86	-14.25	-8.07	-3.77
170	23.25	24.90	26.80	-5.45	-8.50	-6.90	21.23	24.77	29.86	-14.54	-8.23	-3.77
180	23.30	24.80	26.50	-5.40	-8.60	-7.20	20.95	24.62	29.86	-14.82	-8.38	-3.77
190	22.15	24.60	26.40	-6.55	-8.80	-7.30	20.70	24.49	29.86	-15.07	-8.51	-3.77
200	21.25	24.50	26.80	-7.45	-8.90	-6.90	20.47	24.37	29.86	-15.30	-8.63	-3.77
210	21.55	24.10	26.50	-7.15	-9.30	-7.20	20.26	24.26	29.86	-15.51	-8.74	-3.77
220	21.30	23.90	26.40	-7.40	-9.50	-7.30	20.07	24.16	29.86	-15.70	-8.84	-3.77
230	23.40	23.70	26.20	-5.30	-9.70	-7.50	19.89	24.07	29.86	-15.88	-8.93	-3.77
240	22.00	23.60	26.20	-6.70	-9.80	-7.50	19.73	23.99	29.86	-16.04	-9.01	-3.77
250	22.20	23.50	26.40	-6.50	-9.90	-7.30	19.58	23.91	29.86	-16.19	-9.09	-3.77
260	22.55	23.30	26.50	-6.15	-10.10	-7.20	19.44	23.84	29.86	-16.33	-9.16	-3.77
270	22.80	23.30	26.80	-5.90	-10.10	-6.90	19.31	23.78	29.86	-16.46	-9.22	-3.77
280	21.85	23.30	26.50	-6.85	-10.10	-7.20	19.20	23.72	29.86	-16.57	-9.28	-3.77
290	21.70	23.20	26.40	-7.00	-10.20	-7.30	19.09	23.67	29.86	-16.68	-9.33	-3.77
300	20.50	23.10	26.50	-8.20	-10.30	-7.20	18.99	23.62	29.86	-16.78	-9.38	-3.77
310	19.65	23.20	26.70	-9.05	-10.20	-7.00	18.90	23.58	29.86	-16.87	-9.42	-3.77
320	21.75	23.40	26.70	-6.95	-10.00	-7.00	18.82	23.54	29.86	-16.95	-9.46	-3.77
330	22.05	23.60	26.70	-6.65	-9.80	-7.00	18.74	23.50	29.86	-17.03	-9.50	-3.77
340	20.80	23.60	27.00	-7.90	-9.80	-6.70	18.67	23.47	29.86	-17.10	-9.53	-3.77
350	20.25	23.50	27.10	-8.45	-9.90	-6.60	18.61	23.44	29.86	-17.16	-9.56	-3.77
360	20.45	23.50	27.20	-8.25	-9.90	-6.50	18.55	23.41	29.85	-17.22	-9.59	-3.78

TABLE A37. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 11				SEX: Male				MODEL PREDICTIONS for SUBJECT No.: 11							
SUIT: RUKKA 8380				WATER TEMP: 31.37 deg F											
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST	
	min	mean	right	BACK	mean	right	BACK								
	(Actual temp.)				(Change in temp.)				(Estimated temp.)				(Change in temp.)		
0	30.90	31.70	34.80	33.70	0.00	0.00	0.00	0.00	32.71	32.75	33.79	0.00	0.00	0.00	
10	29.80	31.00	34.70	33.30	-1.10	-0.70	-0.10	-0.40	27.55	27.76	30.45	-5.16	-4.99	-3.34	
20	29.00	30.10	34.60	33.30	-1.90	-1.60	-0.20	-0.40	25.37	25.97	29.37	-7.34	-6.78	-4.42	
30	28.20	29.60	34.40	33.10	-2.70	-2.10	-0.40	-0.60	23.58	25.13	29.13	-9.13	-7.62	-4.66	
40	28.05	29.40	34.40	32.90	-2.85	-2.30	-0.40	-0.80	22.01	24.86	29.25	-10.70	-7.89	-4.54	
50	26.65	29.10	34.00	32.20	-4.25	-2.60	-0.80	-1.50	20.60	24.73	29.35	-12.11	-8.02	-4.44	
60	25.65	29.10	33.70	31.70	-5.25	-2.60	-1.10	-2.00	19.31	24.70	29.44	-13.40	-8.05	-4.35	
70	25.25	29.10	33.70	31.20	-5.65	-2.60	-1.10	-2.50	18.16	24.74	29.50	-14.55	-8.01	-4.29	
80	24.35	29.40	33.40	30.80	-6.55	-2.30	-1.40	-2.90	17.14	24.82	29.55	-15.57	-7.93	-4.24	
90	24.10	29.10	33.30	30.20	-6.80	-2.60	-1.50	-3.50	16.21	24.91	29.56	-16.50	-7.84	-4.23	
100	23.95	29.00	33.10	29.70	-6.95	-2.70	-1.70	-4.00	15.38	25.00	29.57	-17.33	-7.75	-4.22	
110	23.55	28.90	32.90	29.00	-7.35	-2.90	-1.90	-4.70	14.65	25.08	29.56	-18.06	-7.67	-4.23	
120	22.70	29.20	33.10	28.70	-8.20	-2.50	-1.70	-5.00	13.98	25.16	29.55	-18.73	-7.59	-4.24	
130	22.60	28.90	33.20	28.40	-8.30	-2.80	-1.60	-5.30	13.39	25.23	29.54	-19.32	-7.52	-4.25	
140	22.05	28.40	32.60	28.10	-8.85	-3.30	-2.20	-5.60	12.86	25.30	29.53	-19.85	-7.45	-4.26	
150	21.75	28.40	32.20	27.80	-9.15	-3.30	-2.60	-5.90	12.38	25.35	29.51	-20.33	-7.40	-4.28	
160	21.45	27.70	32.50	27.40	-9.45	-4.00	-2.30	-6.30	11.95	25.39	29.50	-20.76	-7.36	-4.29	
170	20.25	27.00	32.00	26.50	-10.65	-4.70	-2.80	-7.20	11.57	25.43	29.49	-21.14	-7.32	-4.30	
180	19.75	26.30	32.40	26.20	-11.15	-5.40	-2.40	-7.50	11.23	25.46	29.48	-21.48	-7.29	-4.31	
190	19.40	26.40	32.30	25.90	-11.50	-5.30	-2.50	-7.90	10.93	25.48	29.47	-21.78	-7.27	-4.32	
200	19.30	26.30	31.80	25.40	-11.60	-5.40	-3.00	-8.30	10.65	25.50	29.46	-22.06	-7.25	-4.33	
210	18.95	26.50	31.60	24.90	-11.95	-5.20	-3.20	-8.80	10.41	25.52	29.45	-22.30	-7.23	-4.34	
220	19.15	26.20	31.50	24.40	-11.75	-5.50	-3.30	-9.30	10.19	25.53	29.45	-22.52	-7.22	-4.34	
230	19.15	26.30	31.90	23.90	-11.75	-5.40	-2.90	-9.80	9.99	25.54	29.44	-22.72	-7.21	-4.35	
240	18.80	26.30	31.90	23.30	-12.10	-5.40	-2.90	-10.40	9.82	25.55	29.44	-22.89	-7.20	-4.35	
250	18.80	26.10	31.80	22.00	-12.10	-5.60	-3.00	-11.70	9.66	25.56	29.43	-23.05	-7.19	-4.36	
260	19.05	26.40	31.80	19.60	-11.85	-5.30	-3.00	-14.10	9.52	25.56	29.43	-23.19	-7.19	-4.36	
270	19.20	26.70	31.80	18.90	-11.70	-5.00	-3.00	-14.80	9.39	25.57	29.42	-23.32	-7.18	-4.37	
280	19.65	26.40	31.80	18.50	-11.25	-5.30	-3.00	-15.20	9.28	25.57	29.42	-23.43	-7.18	-4.37	
290	19.35	26.30	32.10	18.30	-11.55	-5.40	-2.70	-15.40	9.18	25.58	29.42	-23.53	-7.17	-4.37	
300	19.20	26.20	31.90	18.00	-11.70	-5.50	-2.90	-15.70	9.09	25.58	29.41	-23.62	-7.17	-4.38	
310	19.25	26.20	32.20	17.00	-11.65	-5.50	-2.60	-16.70	9.01	25.58	29.41	-23.70	-7.17	-4.38	
320	18.75	25.90	31.90	16.20	-12.15	-5.80	-2.90	-17.50	8.94	25.58	29.41	-23.77	-7.17	-4.38	
330	19.00	25.90	32.00	16.00	-11.90	-5.80	-2.80	-17.70	8.87	25.58	29.41	-23.84	-7.17	-4.38	
340	18.75	25.50	32.00	15.60	-12.15	-6.20	-2.80	-18.10	8.81	25.58	29.40	-23.90	-7.17	-4.39	
350	19.10	26.30	32.20	15.80	-11.80	-5.40	-2.60	-17.90	8.76	25.58	29.40	-23.95	-7.17	-4.39	
360	19.20	25.40	32.20	14.90	-11.70	-6.30	-2.60	-18.80	8.71	25.58	29.40	-24.00	-7.17	-4.39	

TABLE A38. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 11			SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 11								
SUIT: RUKKA 8380			WATER TEMP: 31.37 deg F											
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH		
min	mean		right	mean		right								
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)				
0	28.30	29.30	29.90	0.00	0.00	0.00	35.78	32.98	33.61	0.00	0.00	0.00		
10	26.65	27.20	27.70	-1.65	-2.10	-2.20	32.01	29.29	29.43	-3.77	-3.69	-4.18		
20	26.45	26.30	26.70	-1.85	-3.00	-3.20	30.45	28.34	28.22	-5.33	-4.64	-5.39		
30	26.10	25.50	25.80	-2.20	-3.80	-4.10	29.28	27.68	27.53	-6.50	-5.30	-6.08		
40	26.70	25.40	25.70	-1.60	-3.90	-4.20	28.30	27.13	27.11	-7.48	-5.85	-6.50		
50	25.00	24.30	24.90	-3.30	-5.00	-5.00	27.44	26.63	26.80	-8.34	-6.35	-6.81		
60	24.55	23.80	24.60	-3.75	-5.50	-5.30	26.66	26.16	26.56	-9.12	-6.82	-7.05		
70	24.30	23.30	24.40	-4.00	-6.00	-5.50	25.96	25.73	26.37	-9.82	-7.25	-7.24		
80	24.05	22.70	24.20	-4.25	-6.60	-5.70	25.31	25.33	26.22	-10.47	-7.65	-7.39		
90	24.25	22.10	23.70	-4.05	-7.20	-6.20	24.70	24.94	26.10	-11.08	-8.04	-7.51		
100	24.30	21.80	23.50	-4.00	-7.50	-6.40	24.15	24.59	26.00	-11.63	-8.39	-7.61		
110	22.55	21.30	23.30	-5.75	-8.00	-6.60	23.63	24.26	25.92	-12.15	-8.72	-7.69		
120	21.45	21.10	23.10	-6.85	-8.20	-6.80	23.14	23.94	25.85	-12.64	-9.04	-7.76		
130	20.60	20.80	22.90	-7.70	-8.50	-7.00	22.70	23.66	25.79	-13.08	-9.32	-7.82		
140	19.25	20.40	22.70	-9.05	-8.90	-7.20	22.29	23.39	25.75	-13.49	-9.59	-7.86		
150	19.60	20.20	22.60	-8.70	-9.10	-7.30	21.90	23.14	25.71	-13.88	-9.84	-7.90		
160	19.65	20.00	22.50	-8.65	-9.30	-7.40	21.54	22.92	25.67	-14.24	-10.06	-7.94		
170	18.70	19.30	21.80	-9.60	-10.00	-8.10	21.21	22.71	25.65	-14.57	-10.27	-7.96		
180	18.10	19.00	21.70	-10.20	-10.30	-8.20	20.90	22.52	25.62	-14.88	-10.46	-7.99		
190	17.50	18.80	21.50	-10.80	-10.50	-8.40	20.61	22.34	25.60	-15.17	-10.64	-8.01		
200	17.45	18.70	21.40	-10.85	-10.60	-8.50	20.34	22.17	25.58	-15.44	-10.81	-8.03		
210	16.70	18.50	21.50	-11.60	-10.80	-8.40	20.09	22.02	25.57	-15.69	-10.96	-8.04		
220	16.80	18.40	21.60	-11.50	-10.90	-8.30	19.86	21.88	25.55	-15.92	-11.10	-8.06		
230	16.80	18.40	21.70	-11.50	-10.90	-8.20	19.65	21.75	25.54	-16.13	-11.23	-8.07		
240	16.75	18.10	22.10	-11.55	-11.20	-7.80	19.45	21.63	25.53	-16.33	-11.35	-8.08		
250	16.10	18.00	22.00	-12.20	-11.30	-7.90	19.27	21.53	25.52	-16.51	-11.45	-8.09		
260	15.90	17.90	22.10	-12.40	-11.40	-7.80	19.09	21.42	25.51	-16.69	-11.56	-8.10		
270	15.95	17.90	22.30	-12.35	-11.40	-7.60	18.93	21.33	25.50	-16.85	-11.65	-8.11		
280	15.95	17.90	22.50	-12.35	-11.40	-7.40	18.78	21.24	25.49	-17.00	-11.74	-8.12		
290	15.70	17.80	22.50	-12.60	-11.50	-7.40	18.65	21.16	25.48	-17.13	-11.82	-8.13		
300	15.55	17.70	22.30	-12.75	-11.60	-7.60	18.52	21.09	25.48	-17.26	-11.89	-8.13		
310	15.10	17.60	22.20	-13.20	-11.70	-7.70	18.40	21.02	25.47	-17.38	-11.96	-8.14		
320	15.05	17.80	22.00	-13.25	-11.50	-7.90	18.29	20.96	25.46	-17.49	-12.02	-8.15		
330	14.85	18.10	21.80	-13.45	-11.20	-8.10	18.18	20.90	25.46	-17.60	-12.08	-8.15		
340	14.70	18.20	21.60	-13.60	-11.10	-8.30	18.08	20.84	25.45	-17.70	-12.14	-8.16		
350	14.55	18.50	21.40	-13.75	-10.80	-8.50	17.99	20.79	25.45	-17.79	-12.19	-8.16		
360	14.60	18.50	21.20	-13.70	-10.80	-8.70	17.91	20.75	25.44	-17.87	-12.23	-8.17		

TABLE A39. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 17				SEX: Male				MODEL PREDICTIONS for SUBJECT No.: 17								
SUIT: RUKKA 8380				WATER TEMP: 31.37 deg F												
TIME	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	LOWER	HAND	ARM	CHEST	HAND	ARM	CHEST		
min	mean	right		BACK	mean	right		BACK								
	(Actual temp.)				(Change in temp.)				(Estimated temp.)			(Change in temp.)				
0	33.70	33.70	33.80	31.80	0.00	0.00	0.00	0.00	32.71	32.75	33.79	0.00	0.00	0.00		
10	31.30	33.20	33.50	31.10	-2.40	-0.50	-0.30	-0.70	27.46	27.98	30.92	-5.25	-4.77	-2.87		
20	30.10	33.00	33.90	30.80	-3.60	-0.70	0.10	-1.00	25.23	26.26	29.97	-7.48	-6.49	-3.82		
30	29.65	32.30	33.90	30.40	-4.05	-1.40	0.10	-1.40	23.35	25.47	29.74	-9.36	-7.28	-4.05		
40	29.50	31.80	33.90	30.20	-4.20	-1.90	0.10	-1.60	21.72	25.53	30.09	-10.99	-7.22	-3.70		
50	29.40	31.80	33.90	29.90	-4.30	-1.90	0.10	-1.90	20.25	25.72	30.32	-12.46	-7.03	-3.47		
60	27.85	31.50	33.90	29.70	-5.85	-2.20	0.10	-2.10	18.92	25.91	30.44	-13.79	-6.84	-3.35		
70	26.90	31.30	34.00	29.40	-6.80	-2.40	0.20	-2.40	17.73	26.06	30.48	-14.98	-6.69	-3.31		
80	26.30	30.70	34.00	29.10	-7.40	-3.00	0.20	-2.70	16.66	26.19	30.50	-16.05	-6.56	-3.29		
90	25.50	30.70	33.90	28.60	-8.20	-3.00	0.10	-3.20	15.69	26.30	30.49	-17.02	-6.45	-3.30		
100	25.05	30.20	34.00	28.10	-8.65	-3.50	0.20	-3.70	14.85	26.40	30.49	-17.86	-6.35	-3.30		
110	24.00	30.00	33.80	27.70	-9.70	-3.70	0.00	-4.10	14.10	26.49	30.48	-18.61	-6.26	-3.31		
120	23.25	29.70	33.90	27.30	-10.45	-4.00	0.10	-4.50	13.42	26.56	30.47	-19.29	-6.19	-3.32		
130	21.65	29.10	33.30	26.90	-12.05	-4.60	-0.50	-4.90	12.83	26.62	30.46	-19.88	-6.13	-3.33		
140	21.25	28.70	33.70	26.60	-12.45	-5.00	-0.10	-5.20	12.30	26.66	30.46	-20.41	-6.09	-3.33		
150	20.10	28.40	33.40	26.30	-13.60	-5.30	-0.40	-5.50	11.83	26.70	30.45	-20.88	-6.05	-3.34		
160	18.50	26.80	33.00	25.90	-15.20	-6.90	-0.80	-5.90	11.42	26.73	30.45	-21.29	-6.02	-3.34		
170	19.35	26.40	33.20	25.60	-14.35	-7.30	-0.60	-6.20	11.05	26.75	30.44	-21.56	-6.00	-3.35		
180	18.30	26.60	33.10	25.30	-15.40	-7.10	-0.70	-6.50	10.73	26.77	30.44	-21.98	-5.98	-3.35		
190	17.25	26.70	33.10	25.10	-16.45	-7.00	-0.70	-6.70	10.40	26.78	30.44	-22.31	-5.97	-3.35		
200	16.95	26.40	33.10	24.70	-16.75	-7.30	-0.70	-7.10	10.18	26.30	30.44	-22.53	-5.95	-3.35		
210	16.60	26.00	32.70	24.00	-17.10	-7.70	-1.10	-7.80	9.95	26.81	30.44	-22.76	-5.94	-3.35		
220	16.45	25.60	32.60	23.10	-17.25	-8.10	-1.20	-8.70	9.75	26.82	30.44	-22.96	-5.93	-3.35		
230	16.15	25.30	32.70	22.60	-17.55	-8.40	-1.10	-9.20	9.58	26.83	30.44	-23.13	-5.92	-3.35		
240	15.60	25.10	32.70	22.40	-18.10	-8.60	-1.10	-9.40	9.42	26.83	30.44	-23.29	-5.92	-3.35		

TABLE A40. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual hand temperature is the mean of both hands.

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HUMAN SUBJECT No.: 17 SEX: Male							MODEL PREDICTIONS for SUBJECT No.: 17					
SUIT: RUKKA 8380 WATER TEMP: 31.37 deg F												
TIME	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH	FOOT	CALF	THIGH
min	mean		right	mean		right						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	29.30	29.80	29.40	0.00	0.00	0.00	35.78	32.98	33.61	0.00	0.00	0.00
10	26.55	28.10	27.50	-2.75	-1.70	-1.90	31.96	29.80	29.87	-3.82	-3.18	-3.74
20	25.75	27.30	26.60	-3.55	-2.50	-2.80	30.40	28.95	28.86	-5.38	-4.03	-4.75
30	24.10	26.30	25.80	-5.20	-3.50	-3.60	29.21	28.29	28.29	-6.57	-4.69	-5.32
40	22.55	25.50	25.20	-6.75	-4.30	-4.20	28.23	27.73	28.02	-7.55	-5.25	-5.59
50	21.45	24.70	24.80	-7.85	-5.10	-4.60	27.36	27.23	27.84	-8.42	-5.75	-5.77
60	20.60	24.30	24.40	-8.70	-5.50	-5.00	26.58	26.76	27.71	-9.20	-6.22	-5.90
70	19.85	23.70	24.10	-9.45	-6.10	-5.30	25.87	26.33	27.61	-9.91	-6.65	-6.00
80	19.20	23.10	23.80	-10.10	-6.70	-5.60	25.22	25.93	27.53	-10.56	-7.05	-6.08
90	18.60	22.70	23.60	-10.70	-7.10	-5.80	24.61	25.56	27.46	-11.17	-7.42	-6.15
100	17.90	22.20	23.50	-11.40	-7.60	-5.90	24.06	25.22	27.42	-11.72	-7.76	-6.19
110	17.30	21.80	23.40	-12.00	-8.00	-6.00	23.56	24.90	27.38	-12.22	-8.08	-6.23
120	16.60	21.40	23.30	-12.70	-8.40	-6.10	23.09	24.62	27.36	-12.69	-8.36	-6.25
130	16.00	21.40	23.20	-13.30	-8.40	-6.20	22.66	24.36	27.34	-13.12	-8.62	-6.27
140	15.40	21.20	23.00	-13.90	-8.60	-6.40	22.27	24.12	27.32	-13.51	-8.86	-6.29
150	14.75	21.00	22.80	-14.55	-8.80	-6.60	21.90	23.90	27.31	-13.88	-9.08	-6.30
160	13.90	20.90	22.70	-15.40	-8.90	-6.70	21.57	23.71	27.30	-14.21	-9.27	-6.31
170	13.60	20.90	22.70	-15.70	-8.90	-6.70	21.26	23.53	27.29	-14.52	-9.45	-6.32
180	13.25	20.60	22.50	-16.05	-9.20	-6.90	20.97	23.37	27.28	-14.81	-9.61	-6.33
190	12.85	20.30	22.40	-16.45	-9.50	-7.00	20.71	23.22	27.28	-15.07	-9.76	-6.33
200	12.45	19.90	22.40	-16.85	-9.90	-7.00	20.47	23.09	27.27	-15.31	-9.89	-6.34
210	11.90	19.80	22.00	-17.40	-10.00	-7.40	20.25	22.96	27.26	-15.53	-10.02	-6.35
220	11.40	19.40	21.90	-17.90	-10.40	-7.50	20.04	22.85	27.26	-15.74	-10.13	-6.35
230	11.05	19.00	21.80	-18.25	-10.80	-7.60	19.86	22.75	27.26	-15.92	-10.23	-6.35
240	10.65	18.70	21.80	-18.65	-11.10	-7.60	19.68	22.65	27.25	-16.10	-10.33	-6.36

TABLE A41. Comparison of human upper body segment temperatures (degrees C) from Pelapu 2 with Model predictions. Actual temperatures and change from initial temperatures are given. Data from group P2-m: male subjects. Actual foot temperature is the mean of both feet.

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HUMAN SUBJECT No.: 1				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 1					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND	CHEST	ARM	HAND	CHEST	ARM	HAND
min	right left			right left								
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	34.00	30.40	30.70	0.00	0.00	0.00	33.80	32.75	32.71	0.00	0.00	0.00
5	33.30	29.90	30.50	-0.70	-0.50	-0.20	31.92	29.59	29.11	-1.88	-3.16	-3.60
10	32.80	29.40	29.40	-1.20	-1.00	-1.30	31.40	28.35	27.58	-2.40	-4.40	-5.13
15	32.40	28.90	28.60	-1.60	-1.50	-2.10	31.10	27.48	26.41	-2.70	-5.27	-6.30
20	31.90	28.60	28.00	-2.10	-1.80	-2.70	30.57	26.68	25.36	-3.23	-6.07	-7.35
25	31.50	28.10	27.10	-2.50	-2.30	-3.60	30.18	26.06	24.39	-3.62	-6.69	-8.32
30	31.10	27.90	26.70	-2.90	-2.50	-4.00	30.14	25.74	23.48	-3.66	-7.01	-9.23
35	30.70	27.50	26.30	-3.30	-2.90	-4.40	30.29	25.70	22.64	-3.51	-7.05	-10.07
40	30.40	27.20	26.10	-3.60	-3.20	-4.60	30.51	25.81	21.83	-3.29	-6.94	-10.88
45	30.30	27.60	25.40	-3.70	-2.80	-5.30	30.73	26.03	21.07	-3.07	-6.72	-11.64
50	30.40	27.80	25.20	-3.60	-2.60	-5.50	30.92	26.28	20.36	-2.88	-6.47	-12.35
55	30.80	27.80	24.70	-3.20	-2.60	-6.00	31.05	26.54	19.68	-2.75	-6.21	-13.03
60	31.20	27.90	24.10	-2.80	-2.50	-6.60	31.14	26.77	19.03	-2.66	-5.98	-13.68
65	31.20	27.70	23.30	-2.80	-2.70	-7.40	31.18	26.94	18.42	-2.62	-5.81	-14.29
70	31.20	27.60	22.70	-2.80	-2.80	-8.00	31.20	27.08	17.84	-2.60	-5.67	-14.87
75	31.20	27.60	22.20	-2.80	-2.80	-8.50	31.20	27.19	17.28	-2.60	-5.56	-15.43
80	31.30	27.70	21.30	-2.70	-2.70	-9.40	31.19	27.27	16.77	-2.61	-5.48	-15.94
85	31.40	27.60	21.30	-2.60	-2.80	-9.40	31.18	27.34	16.27	-2.62	-5.41	-16.44
90	31.60	27.50	20.90	-2.40	-2.90	-9.80	31.17	27.39	15.80	-2.63	-5.36	-16.91
95	31.40	27.20	20.40	-2.60	-3.20	-10.30	31.16	27.44	15.37	-2.64	-5.31	-17.34
100	31.10	26.70	20.70	-2.90	-3.70	-10.00	31.15	27.48	14.95	-2.65	-5.27	-17.76
105	31.30	26.50	20.80	-2.70	-3.90	-9.90	31.14	27.52	14.56	-2.66	-5.23	-18.15
110	31.30	26.60	21.20	-2.70	-3.80	-9.50	31.14	27.56	14.20	-2.66	-5.19	-18.51
115	31.40	25.80	21.20	-2.60	-4.60	-9.50	31.13	27.59	13.85	-2.67	-5.16	-18.86
120	31.50	25.50	20.80	-2.50	-4.90	-9.90	31.12	27.62	13.52	-2.68	-5.13	-19.19
125	31.60	25.10	20.80	-2.40	-5.30	-9.90	31.12	27.64	13.22	-2.68	-5.11	-19.49
130	31.70	25.10	21.00	-2.30	-5.30	-9.70	31.11	27.66	12.93	-2.69	-5.09	-19.78
135	31.80	24.90	20.80	-2.20	-5.50	-9.90	31.10	27.68	12.66	-2.70	-5.07	-20.05
140	31.70	24.90	20.60	-2.30	-5.50	-10.10	31.10	27.70	12.41	-2.70	-5.05	-20.30
145	31.70	24.70	19.80	-2.30	-5.70	-10.90	31.10	27.71	12.17	-2.70	-5.04	-20.54
150	31.60	24.30	19.10	-2.40	-6.10	-11.60	31.09	27.73	11.94	-2.71	-5.02	-20.77
155	31.60	24.20	18.40	-2.40	-6.20	-12.30	31.09	27.74	11.73	-2.71	-5.01	-20.98
160	31.70	24.10	18.50	-2.30	-6.30	-12.20	31.09	27.75	11.53	-2.71	-5.00	-21.18
165	31.70	24.10	18.20	-2.30	-6.30	-12.50	31.08	27.76	11.34	-2.72	-4.99	-21.37
170	31.80	24.30	18.40	-2.20	-6.10	-12.30	31.08	27.77	11.17	-2.72	-4.98	-21.54
175	31.90	24.10	18.00	-2.10	-6.30	-12.70	31.08	27.77	11.00	-2.72	-4.98	-21.71
180	31.60	24.00	17.60	-2.40	-6.40	-13.10	31.08	27.78	10.85	-2.72	-4.97	-21.86
185	31.60	24.00	17.60	-2.40	-6.40	-13.10	31.08	27.79	10.70	-2.72	-4.96	-22.01
190	31.70	23.70	17.00	-2.30	-6.70	-13.70	31.08	27.79	10.56	-2.72	-4.96	-22.15
195	31.70	23.50	17.10	-2.30	-6.90	-13.60	31.08	27.80	10.43	-2.72	-4.95	-22.28
200	31.70	23.40	16.70	-2.30	-7.00	-14.00	31.08	27.80	10.31	-2.72	-4.95	-22.40

TABLE A42. Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 1				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 1					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
min		left	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	33.40	29.50	31.80	0.00	0.00	0.00	34.75	33.61	32.99	0.00	0.00	0.00
5	33.40	28.80	31.30	0.00	-0.70	-0.50	33.35	31.27	31.01	-1.40	-2.34	-1.98
10	33.10	28.10	30.70	-0.30	-1.40	-1.10	32.90	30.54	30.43	-1.85	-3.07	-2.56
15	32.70	27.50	30.20	-0.70	-2.00	-1.60	32.73	30.04	30.02	-2.02	-3.57	-2.97
20	32.20	27.00	29.70	-1.20	-2.50	-2.10	32.20	29.63	29.64	-2.55	-3.98	-3.35
25	31.90	26.30	29.30	-1.50	-3.20	-2.50	31.64	29.30	29.28	-3.11	-4.31	-3.71
30	31.60	26.20	28.80	-1.80	-3.30	-3.00	31.26	29.09	28.97	-3.49	-4.52	-4.02
35	31.30	25.80	28.40	-2.10	-3.70	-3.40	30.99	28.95	28.68	-3.76	-4.66	-4.31
40	31.10	25.60	28.20	-2.30	-3.90	-3.60	30.79	28.86	28.41	-3.96	-4.75	-4.58
45	31.00	26.40	28.60	-2.40	-3.10	-3.20	30.65	28.81	28.15	-4.10	-4.80	-4.84
50	30.70	26.00	27.90	-2.70	-3.50	-3.90	30.55	28.78	27.91	-4.20	-4.83	-5.08
55	30.90	25.70	27.40	-2.50	-3.80	-4.40	30.48	28.76	27.67	-4.27	-4.85	-5.32
60	31.00	25.30	27.20	-2.40	-4.20	-4.60	30.42	28.75	27.44	-4.33	-4.86	-5.55
65	30.90	24.80	26.90	-2.50	-4.70	-4.90	30.39	28.73	27.22	-4.36	-4.88	-5.77
70	31.10	24.50	26.60	-2.30	-5.00	-5.20	30.36	28.71	27.00	-4.39	-4.90	-5.99
75	31.40	24.40	26.20	-2.00	-5.10	-5.60	30.34	28.68	26.80	-4.41	-4.93	-6.19
80	31.60	24.20	25.80	-1.80	-5.30	-6.00	30.32	28.66	26.60	-4.43	-4.95	-6.39
85	31.70	24.10	25.60	-1.70	-5.40	-6.20	30.31	28.64	26.41	-4.44	-4.97	-6.58
90	31.80	23.70	25.30	-1.60	-5.80	-6.50	30.30	28.61	26.23	-4.45	-5.00	-6.76
95	31.40	24.10	25.50	-2.00	-5.40	-6.30	30.30	28.60	26.05	-4.45	-5.01	-6.94
100	31.70	24.10	25.80	-1.70	-5.40	-6.00	30.31	28.58	25.89	-4.44	-5.03	-7.10
105	31.90	23.90	25.50	-1.50	-5.60	-6.30	30.31	28.57	25.73	-4.44	-5.04	-7.26
110	31.60	23.90	25.20	-1.80	-5.60	-6.60	30.32	28.56	25.58	-4.43	-5.05	-7.41
115	31.60	23.70	24.80	-1.80	-5.80	-7.00	30.33	28.55	25.43	-4.42	-5.06	-7.56
120	31.60	23.60	24.50	-1.80	-5.90	-7.30	30.35	28.54	25.29	-4.40	-5.07	-7.70
125	31.70	23.50	24.30	-1.70	-6.00	-7.50	30.36	28.54	25.17	-4.39	-5.07	-7.82
130	31.70	23.50	23.90	-1.70	-6.00	-7.90	30.38	28.53	25.04	-4.37	-5.08	-7.95
135	31.80	23.40	23.90	-1.60	-6.10	-7.90	30.39	28.52	24.92	-4.36	-5.09	-8.07
140	31.70	23.40	23.70	-1.70	-6.10	-8.10	30.41	28.52	24.81	-4.34	-5.09	-8.18
145	31.60	23.40	23.50	-1.80	-6.10	-8.30	30.42	28.52	24.70	-4.33	-5.09	-8.29
150	31.50	23.10	23.40	-1.90	-6.40	-8.40	30.43	28.51	24.60	-4.32	-5.10	-8.39
155	31.50	23.30	23.40	-1.90	-6.20	-8.40	30.45	28.51	24.51	-4.30	-5.10	-8.48
160	31.40	22.50	23.80	-2.00	-7.00	-8.00	30.46	28.50	24.41	-4.29	-5.11	-8.58
165	31.50	23.40	24.00	-1.90	-6.10	-7.80	30.47	28.50	24.33	-4.28	-5.11	-8.66
170	31.60	23.40	23.60	-1.80	-6.10	-8.20	30.48	28.50	24.24	-4.27	-5.11	-8.75
175	31.70	23.30	23.60	-1.70	-6.20	-8.20	30.49	28.50	24.16	-4.26	-5.11	-8.83
180	31.60	23.40	23.20	-1.80	-6.10	-8.60	30.50	28.49	24.09	-4.25	-5.12	-8.90
185	31.60	23.50	23.30	-1.80	-6.00	-8.50	30.51	28.49	24.02	-4.24	-5.12	-8.97
190	31.60	23.50	22.80	-1.80	-6.00	-9.00	30.52	28.49	23.95	-4.23	-5.12	-9.04
195	31.50	21.30	22.80	-1.90	-8.20	-9.00	30.53	28.49	23.88	-4.22	-5.12	-9.11
200	31.50	21.70	22.60	-1.90	-7.80	-9.20	30.53	28.49	23.82	-4.22	-5.12	-9.17

TABLE A43. Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

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HUMAN SUBJECT No.: 3				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 3					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME min	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND*	CHEST	ARM	HAND	CHEST	ARM	HAND
	(Actual temp.)	(Actual temp.)	(Actual temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)	(Estimated temp.)	(Estimated temp.)	(Estimated temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)
0	34.40	30.70	?	0.00	0.00	?	33.80	32.76	32.71	0.00	0.00	0.00
5	33.80	30.00	?	-0.60	-0.70	?	31.88	29.57	29.11	-1.92	-3.19	-3.60
10	33.40	29.50	?	-1.00	-1.20	?	31.33	28.31	27.58	-2.47	-4.45	-5.13
15	32.70	28.80	?	-1.70	-1.90	?	31.01	27.43	26.42	-2.79	-5.33	-6.29
20	32.10	28.20	?	-2.30	-2.50	?	30.49	26.64	25.37	-3.31	-6.12	-7.34
25	31.90	27.90	28.20	-2.50	-2.80	0.00	30.12	26.03	24.40	-3.68	-6.73	-8.31
30	31.40	27.50	27.60	-3.00	-3.20	-0.60	30.07	25.71	23.50	-3.73	-7.05	-9.21
35	31.00	27.10	27.00	-3.40	-3.60	-1.20	30.21	25.65	22.68	-3.59	-7.11	-10.03
40	30.70	26.80	26.20	-3.70	-3.90	-2.00	30.42	25.75	21.88	-3.38	-7.01	-10.83
45	30.50	26.50	25.40	-3.90	-4.20	-2.80	30.64	25.94	21.12	-3.16	-6.82	-11.59
50	30.50	26.20	25.00	-3.90	-4.50	-3.20	30.82	26.18	20.42	-2.98	-6.58	-12.29
55	30.40	25.90	24.00	-4.00	-4.80	-4.20	30.95	26.42	19.73	-2.85	-6.34	-12.98
60	30.50	25.70	23.80	-3.90	-5.00	-4.40	31.03	26.63	19.09	-2.77	-6.13	-13.62
65	30.40	25.50	22.20	-4.00	-5.20	-6.00	31.07	26.78	18.49	-2.73	-5.98	-14.22
70	30.30	25.30	21.40	-4.10	-5.40	-6.80	31.08	26.91	17.90	-2.72	-5.85	-14.81
75	30.40	25.00	20.90	-4.00	-5.70	-7.30	31.09	27.01	17.35	-2.71	-5.75	-15.36
80	30.30	24.70	20.50	-4.10	-6.00	-7.70	31.08	27.09	16.84	-2.72	-5.67	-15.87
85	30.40	24.40	20.20	-4.00	-6.30	-8.00	31.08	27.16	16.34	-2.72	-5.60	-16.37
90	30.40	24.30	20.00	-4.00	-6.40	-8.20	31.06	27.21	15.88	-2.74	-5.55	-16.83
95	30.50	24.20	19.50	-3.90	-6.50	-8.70	31.05	27.26	15.45	-2.75	-5.50	-17.26
100	30.80	23.90	19.00	-3.60	-6.80	-9.20	31.04	27.30	15.03	-2.76	-5.46	-17.68
105	31.00	23.80	18.50	-3.40	-6.90	-9.70	31.03	27.34	14.64	-2.77	-5.42	-18.07
110	31.10	23.80	18.00	-3.30	-6.90	-10.20	31.02	27.38	14.28	-2.78	-5.38	-18.43
115	31.20	23.80	17.80	-3.20	-6.90	-10.40	31.02	27.41	13.94	-2.78	-5.35	-18.77
120	31.30	23.70	17.80	-3.10	-7.00	-10.40	31.01	27.44	13.61	-2.79	-5.32	-19.10
125	31.20	23.40	16.50	-3.20	-7.30	-11.70	31.00	27.46	13.31	-2.80	-5.30	-19.40
130	31.30	23.30	16.00	-3.10	-7.40	-12.20	30.99	27.49	13.02	-2.81	-5.27	-19.69
135	31.40	23.20	15.80	-3.00	-7.50	-12.40	30.99	27.51	12.75	-2.81	-5.25	-19.96
140	31.40	23.20	15.80	-3.00	-7.50	-12.40	30.98	27.53	12.50	-2.82	-5.23	-20.21
145	31.60	23.30	15.40	-2.80	-7.40	-12.80	30.98	27.54	12.26	-2.82	-5.22	-20.45
150	31.50	23.40	15.00	-2.90	-7.30	-13.20	30.97	27.56	12.03	-2.83	-5.20	-20.68

TABLE A44. Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.
*: Data referenced to first recorded temperature (28.2C).

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HUMAN SUBJECT No.: 3				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 3					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME min	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND*	CHEST	ARM	HAND	CHEST	ARM	HAND
		right	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
155	31.50	23.40	14.80	-2.90	-7.30	-13.40	30.97	27.57	11.82	-2.83	-5.19	-20.89
160	31.40	23.30	14.80	-3.00	-7.40	-13.40	30.96	27.58	11.62	-2.84	-5.18	-21.09
165	31.30	23.40	14.60	-3.10	-7.30	-13.60	30.96	27.59	11.43	-2.84	-5.17	-21.28
170	31.20	23.50	14.60	-3.20	-7.20	-13.60	30.96	27.60	11.25	-2.84	-5.16	-21.46
175	31.20	23.40	14.60	-3.20	-7.30	-13.60	30.96	27.61	11.08	-2.84	-5.15	-21.63
180	31.30	23.60	14.80	-3.10	-7.10	-13.40	30.95	27.61	10.93	-2.85	-5.15	-21.78
185	31.40	24.10	14.30	-3.00	-6.60	-13.90	30.95	27.62	10.78	-2.85	-5.14	-21.93
190	31.30	24.60	14.10	-3.10	-6.10	-14.10	30.95	27.63	10.64	-2.85	-5.13	-22.07
195	31.10	24.50	14.10	-3.30	-6.20	-14.10	30.95	27.63	10.51	-2.85	-5.13	-22.20
200	31.10	24.50	14.40	-3.30	-6.20	-13.80	30.95	27.64	10.38	-2.85	-5.12	-22.33
205	31.20	24.60	14.20	-3.20	-6.10	-14.00	30.95	27.64	10.27	-2.85	-5.12	-22.44
210	31.30	24.90	13.80	-3.10	-5.80	-14.40	30.95	27.65	10.16	-2.85	-5.11	-22.55
215	31.30	24.80	14.10	-3.10	-5.90	-14.10	30.94	27.65	10.05	-2.86	-5.11	-22.66
220	31.30	24.50	14.00	-3.10	-6.20	-14.20	30.94	27.65	9.96	-2.86	-5.11	-22.75
225	31.40	24.50	14.20	-3.00	-6.20	-14.00	30.94	27.66	9.86	-2.86	-5.10	-22.85
230	31.40	24.30	14.00	-3.00	-6.40	-14.20	30.94	27.66	9.78	-2.86	-5.10	-22.93
235	31.40	24.10	14.30	-3.00	-6.60	-13.90	30.94	27.66	9.70	-2.86	-5.10	-23.01
240	31.40	24.00	14.60	-3.00	-6.70	-13.60	30.94	27.67	9.62	-2.86	-5.09	-23.09
245	31.30	23.90	15.00	-3.10	-6.80	-13.20	30.94	27.67	9.55	-2.86	-5.09	-23.16
250	31.20	23.80	15.60	-3.20	-6.90	-12.60	30.94	27.67	9.48	-2.86	-5.09	-23.23
255	31.30	24.10	15.40	-3.10	-6.60	-12.80	30.94	27.67	9.42	-2.86	-5.09	-23.29
260	31.40	24.10	15.80	-3.00	-6.60	-12.40	30.94	27.68	9.36	-2.86	-5.08	-23.35
265	31.40	24.10	16.00	-3.00	-6.60	-12.20	30.94	27.68	9.30	-2.86	-5.08	-23.41
270	31.30	24.10	15.80	-3.10	-6.60	-12.40	30.94	27.68	9.25	-2.86	-5.08	-23.46
275	31.30	24.10	15.40	-3.10	-6.60	-12.80	30.94	27.68	9.20	-2.86	-5.08	-23.51
280	31.50	24.40	15.00	-2.90	-6.30	-13.20	30.94	27.68	9.15	-2.86	-5.08	-23.56
285	31.40	24.30	14.80	-3.00	-6.40	-13.40	30.94	27.68	9.10	-2.86	-5.08	-23.61
290	31.40	24.40	14.80	-3.00	-6.30	-13.40	30.94	27.68	9.06	-2.86	-5.08	-23.65
295	31.20	24.40	15.20	-3.20	-6.30	-13.00	30.94	27.68	9.02	-2.86	-5.08	-23.69
300	31.20	24.50	16.00	-3.20	-6.20	-12.20	30.94	27.69	8.99	-2.86	-5.07	-23.72

TABLE A44 (con'd). Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

*: Data referenced to first recorded temperature (28.2C).

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HUMAN SUBJECT No.: 3				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 3					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
min	left left left			right left								
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.90	32.10	32.30	0.00	0.00	0.00	34.75	33.61	32.99	0.00	0.00	0.00
5	32.50	31.10	31.40	-0.40	-1.00	-0.90	33.34	31.22	30.96	-1.41	-2.39	-2.03
10	32.60	30.30	31.00	-0.30	-1.80	-1.30	32.85	30.47	30.37	-1.90	-3.14	-2.62
15	32.50	29.40	30.40	-0.40	-2.70	-1.90	32.64	29.97	29.96	-2.11	-3.64	-3.03
20	32.30	28.60	29.90	-0.60	-3.50	-2.40	32.13	29.56	29.58	-2.62	-4.05	-3.41
25	32.20	28.10	29.40	-0.70	-4.00	-2.90	31.58	29.23	29.23	-3.17	-4.38	-3.76
30	32.10	27.60	28.90	-0.80	-4.50	-3.40	31.20	29.01	28.92	-3.55	-4.60	-4.07
35	32.00	27.10	28.50	-0.90	-5.00	-3.80	30.93	28.87	28.63	-3.82	-4.74	-4.36
40	31.70	26.70	28.10	-1.20	-5.40	-4.20	30.73	28.78	28.36	-4.02	-4.83	-4.63
45	31.50	26.30	27.60	-1.40	-5.80	-4.70	30.58	28.71	28.10	-4.17	-4.90	-4.89
50	31.40	25.90	27.30	-1.50	-6.20	-5.00	30.48	28.68	27.86	-4.27	-4.93	-5.13
55	31.10	25.60	26.90	-1.80	-6.50	-5.40	30.40	28.65	27.62	-4.35	-4.96	-5.37
60	31.00	25.30	26.70	-1.90	-6.80	-5.60	30.34	28.63	27.39	-4.41	-4.98	-5.60
65	30.90	25.00	26.30	-2.00	-7.10	-6.00	30.30	28.60	27.17	-4.45	-5.01	-5.82
70	30.90	24.80	26.00	-2.00	-7.30	-6.30	30.26	28.57	26.96	-4.49	-5.04	-6.03
75	30.80	24.60	25.70	-2.10	-7.50	-6.60	30.23	28.55	26.75	-4.52	-5.06	-6.24
80	30.80	24.40	25.50	-2.10	-7.70	-6.80	30.21	28.52	26.55	-4.54	-5.09	-6.44
85	30.70	24.20	25.20	-2.20	-7.90	-7.10	30.20	28.49	26.36	-4.55	-5.12	-6.63
90	30.50	24.20	24.90	-2.40	-7.90	-7.40	30.19	28.47	26.18	-4.56	-5.14	-6.81
95	30.40	24.00	24.70	-2.50	-8.10	-7.60	30.18	28.45	26.00	-4.57	-5.16	-6.99
100	30.50	23.70	24.50	-2.40	-8.40	-7.80	30.18	28.43	25.83	-4.57	-5.18	-7.16
105	30.40	23.70	24.30	-2.50	-8.40	-8.00	30.19	28.41	25.67	-4.56	-5.20	-7.32
110	30.40	23.60	24.10	-2.50	-8.50	-8.20	30.19	28.40	25.52	-4.56	-5.21	-7.47
115	30.50	23.60	23.90	-2.40	-8.50	-8.40	30.20	28.39	25.37	-4.55	-5.22	-7.62
120	30.70	23.40	23.70	-2.20	-8.70	-8.60	30.21	28.38	25.23	-4.54	-5.23	-7.76
125	30.70	23.40	23.50	-2.20	-8.70	-8.80	30.23	28.37	25.10	-4.52	-5.24	-7.89
130	30.70	23.40	23.40	-2.20	-8.70	-8.90	30.24	28.36	24.97	-4.51	-5.25	-8.02
135	30.70	23.40	23.20	-2.20	-8.70	-9.10	30.25	28.36	24.85	-4.50	-5.25	-8.14
140	30.70	23.40	23.00	-2.20	-8.70	-9.30	30.27	28.35	24.74	-4.48	-5.26	-8.25
145	30.90	23.30	22.90	-2.00	-8.80	-9.40	30.28	28.34	24.63	-4.47	-5.27	-8.36
150	30.90	23.40	22.80	-2.00	-8.70	-9.50	30.29	28.34	24.52	-4.46	-5.27	-8.47

TABLE A45. Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 3				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 3					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
min		left	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
155	30.90	23.40	22.70	-2.00	-8.70	-9.60	30.30	28.33	24.43	-4.45	-5.28	-8.56
160	31.00	23.30	22.50	-1.90	-8.80	-9.80	30.32	28.33	24.33	-4.43	-5.28	-8.66
165	30.90	23.30	22.40	-2.00	-8.80	-9.90	30.33	28.33	24.24	-4.42	-5.28	-8.75
170	30.90	23.20	22.30	-2.00	-8.90	-10.00	30.34	28.32	24.15	-4.41	-5.29	-8.84
175	31.00	23.20	22.20	-1.90	-8.90	-10.10	30.35	28.32	24.07	-4.40	-5.29	-8.92
180	31.10	23.30	22.10	-1.80	-8.80	-10.20	30.36	28.32	23.99	-4.39	-5.29	-9.00
185	31.30	23.60	22.10	-1.60	-8.50	-10.20	30.37	28.31	23.92	-4.38	-5.30	-9.07
190	31.30	23.60	21.90	-1.60	-8.50	-10.40	30.37	28.31	23.85	-4.38	-5.30	-9.14
195	31.30	23.50	21.80	-1.60	-8.60	-10.50	30.38	28.31	23.78	-4.37	-5.30	-9.21
200	31.30	23.50	21.80	-1.60	-8.60	-10.50	30.39	28.31	23.71	-4.36	-5.30	-9.28
205	31.50	23.50	21.70	-1.40	-8.60	-10.60	30.39	28.30	23.65	-4.36	-5.31	-9.34
210	31.60	23.40	21.60	-1.30	-8.70	-10.70	30.40	28.30	23.59	-4.35	-5.31	-9.40
215	31.80	23.50	21.50	-1.10	-8.60	-10.80	30.41	28.30	23.54	-4.34	-5.31	-9.45
220	31.60	23.60	21.40	-1.30	-8.50	-10.90	30.41	28.30	23.48	-4.34	-5.31	-9.51
225	31.60	23.50	21.30	-1.30	-8.60	-11.00	30.42	28.30	23.43	-4.33	-5.31	-9.56
230	31.60	23.70	21.20	-1.30	-8.40	-11.10	30.42	28.30	23.38	-4.33	-5.31	-9.61
235	31.70	23.80	21.20	-1.20	-8.30	-11.10	30.43	28.29	23.34	-4.32	-5.32	-9.65
240	31.80	23.90	21.10	-1.10	-8.20	-11.20	30.43	28.29	23.29	-4.32	-5.32	-9.70
245	31.90	23.80	21.00	-1.00	-8.30	-11.30	30.43	28.29	23.25	-4.32	-5.32	-9.74
250	31.90	23.70	21.00	-1.00	-8.40	-11.30	30.44	28.29	23.21	-4.31	-5.32	-9.78
255	32.10	23.80	20.90	-0.80	-8.30	-11.40	30.44	28.29	23.17	-4.31	-5.32	-9.82
260	32.20	24.00	20.90	-0.70	-8.10	-11.40	30.44	28.29	23.13	-4.31	-5.32	-9.86
265	32.30	24.10	21.00	-0.60	-8.00	-11.30	30.45	28.29	23.09	-4.30	-5.32	-9.90
270	32.30	24.00	21.10	-0.60	-8.10	-11.20	30.45	28.28	23.06	-4.30	-5.33	-9.93
275	32.30	24.00	21.20	-0.60	-8.10	-11.10	30.45	28.28	23.03	-4.30	-5.33	-9.96
280	32.20	24.10	21.20	-0.70	-8.00	-11.10	30.45	28.28	23.00	-4.30	-5.33	-9.99
285	32.10	24.10	21.10	-0.80	-8.00	-11.20	30.45	28.28	22.96	-4.30	-5.33	-10.03
290	32.00	24.30	21.10	-0.90	-7.80	-11.20	30.45	28.28	22.94	-4.30	-5.33	-10.05
295	32.00	24.90	21.20	-0.90	-7.20	-11.10	30.46	28.28	22.91	-4.29	-5.33	-10.08
300	31.80	25.30	21.20	-1.10	-6.80	-11.10	30.46	28.28	22.88	-4.29	-5.33	-10.11

TABLE A45 (con'd). Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

NAWCADWA.R-93069-60

HUMAN SUBJECT No.: 4				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 4					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND	CHEST	ARM	HAND	CHEST	ARM	HAND
min		right	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.80	29.80	27.50	0.00	0.00	0.00	33.79	32.76	32.72	0.00	0.00	0.00
5	32.30	29.40	27.30	-0.50	-0.40	-0.20	31.40	29.26	29.14	-2.39	-3.50	-3.58
10	31.70	28.80	26.70	-1.10	-1.00	-0.80	30.48	27.81	27.16	-3.31	-4.95	-5.56
15	31.10	28.30	26.20	-1.70	-1.50	-1.30	29.91	26.81	26.43	-3.88	-5.95	-6.29
20	30.50	27.80	25.50	-2.30	-2.00	-2.00	29.41	26.05	25.44	-4.38	-6.71	-7.28
25	30.00	27.40	24.80	-2.80	-2.40	-2.70	29.18	25.51	24.53	-4.61	-7.25	-8.19
30	29.50	27.10	24.40	-3.30	-2.70	-3.10	29.17	25.21	23.67	-4.62	-7.55	-9.05
35	29.20	26.90	23.80	-3.60	-2.90	-3.70	29.24	25.06	22.89	-4.55	-7.70	-9.83
40	28.80	26.60	23.10	-4.00	-3.20	-4.40	29.29	24.94	22.13	-4.50	-7.82	-10.59
45	28.40	26.20	22.50	-4.40	-3.60	-5.00	29.35	24.87	21.40	-4.44	-7.89	-11.32
50	28.10	25.90	22.00	-4.70	-3.90	-5.50	29.40	24.82	20.73	-4.39	-7.94	-11.99
55	27.90	25.60	21.20	-4.90	-4.20	-6.30	29.44	24.80	20.08	-4.35	-7.96	-12.64
60	27.60	25.30	20.90	-5.20	-4.50	-6.60	29.49	24.80	19.46	-4.30	-7.96	-13.26
65	27.50	25.00	20.30	-5.30	-4.80	-7.20	29.52	24.82	18.88	-4.27	-7.94	-13.84
70	27.30	24.70	19.80	-5.50	-5.10	-7.70	29.55	24.85	18.32	-4.24	-7.91	-14.40
75	27.20	24.50	19.20	-5.60	-5.30	-8.30	29.57	24.88	17.80	-4.22	-7.88	-14.92
80	27.10	24.30	18.60	-5.70	-5.50	-8.90	29.59	24.92	17.31	-4.20	-7.84	-15.41
85	27.10	24.10	17.90	-5.70	-5.70	-9.60	29.60	24.97	16.83	-4.19	-7.79	-15.89
90	27.10	24.00	17.60	-5.70	-5.80	-9.90	29.60	25.01	16.39	-4.19	-7.75	-16.33
95	27.10	23.80	17.40	-5.70	-6.00	-10.10	29.60	25.06	15.97	-4.19	-7.70	-16.75
100	27.20	23.60	17.00	-5.60	-6.20	-10.50	29.60	25.10	15.57	-4.19	-7.66	-17.15
105	27.20	23.50	16.90	-5.60	-6.30	-10.60	29.60	25.14	15.19	-4.19	-7.62	-17.53
110	27.30	23.30	16.80	-5.50	-6.50	-10.70	29.59	25.18	14.84	-4.20	-7.58	-17.88
115	27.40	23.20	16.80	-5.40	-6.60	-10.70	29.59	25.22	14.50	-4.20	-7.54	-18.22
120	27.50	23.00	16.60	-5.30	-6.80	-10.90	29.58	25.26	14.18	-4.21	-7.50	-18.54
125	27.50	22.80	16.30	-5.30	-7.00	-11.20	29.57	25.29	13.88	-4.22	-7.47	-18.84
130	27.50	22.70	16.40	-5.30	-7.10	-11.10	29.56	25.33	13.60	-4.23	-7.43	-19.12
135	27.40	22.60	16.20	-5.40	-7.20	-11.30	29.56	25.36	13.32	-4.23	-7.40	-19.40
140	27.40	22.60	16.20	-5.40	-7.20	-11.30	29.55	25.39	13.07	-4.24	-7.37	-19.65
145	27.40	22.50	16.30	-5.40	-7.30	-11.20	29.54	25.41	12.83	-4.25	-7.35	-19.89
150	27.40	22.40	16.20	-5.40	-7.40	-11.30	29.53	25.44	12.60	-4.26	-7.32	-20.12

TABLE A46. Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 4				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 4					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND	CHEST	ARM	HAND	CHEST	ARM	HAND
min		right	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
155	27.50	22.30	16.10	-5.30	-7.50	-11.40	29.53	25.46	12.38	-4.26	-7.30	-20.34
160	27.50	22.30	16.10	-5.30	-7.50	-11.40	29.52	25.48	12.18	-4.27	-7.28	-20.54
165	27.40	22.30	16.20	-5.40	-7.50	-11.30	29.51	25.50	11.98	-4.28	-7.26	-20.74
170	27.50	22.20	16.10	-5.30	-7.60	-11.40	29.51	25.51	11.80	-4.28	-7.25	-20.92
175	27.50	22.00	16.00	-5.30	-7.80	-11.50	29.50	25.53	11.62	-4.29	-7.23	-21.10
180	27.50	21.90	15.90	-5.30	-7.90	-11.60	29.50	25.54	11.46	-4.29	-7.22	-21.26
185	27.50	21.90	15.80	-5.30	-7.90	-11.70	29.49	25.55	11.30	-4.30	-7.21	-21.42
190	27.50	21.90	15.70	-5.30	-7.90	-11.80	29.49	25.56	11.16	-4.30	-7.20	-21.56
195	27.50	22.00	15.50	-5.30	-7.80	-12.00	29.48	25.57	11.01	-4.31	-7.19	-21.71
200	27.50	22.00	15.60	-5.30	-7.80	-11.90	29.48	25.58	10.88	-4.31	-7.18	-21.84
205	27.40	21.90	15.60	-5.40	-7.90	-11.90	29.47	25.59	10.76	-4.32	-7.17	-21.96
210	27.40	22.00	15.30	-5.40	-7.80	-12.20	29.47	25.59	10.64	-4.32	-7.17	-22.08
215	27.40	21.90	15.70	-5.40	-7.90	-11.80	29.47	25.60	10.53	-4.32	-7.16	-22.19
220	27.30	21.90	15.70	-5.50	-7.90	-11.80	29.46	25.61	10.42	-4.33	-7.15	-22.30
225	27.40	22.10	15.60	-5.40	-7.70	-11.90	29.46	25.61	10.32	-4.33	-7.15	-22.40
230	27.30	22.10	15.30	-5.50	-7.70	-12.20	29.46	25.62	10.23	-4.33	-7.14	-22.49
235	27.30	21.70	15.60	-5.50	-8.10	-11.90	29.45	25.62	10.14	-4.34	-7.14	-22.58
240	27.20	21.70	15.40	-5.60	-8.10	-12.10	29.45	25.62	10.05	-4.34	-7.14	-22.67
245	27.20	21.60	15.50	-5.60	-8.20	-12.00	29.45	25.63	9.97	-4.34	-7.13	-22.75
250	27.10	21.50	15.40	-5.70	-8.30	-12.10	29.45	25.63	9.90	-4.34	-7.13	-22.82
255	27.10	21.50	15.50	-5.70	-8.30	-12.00	29.44	25.63	9.82	-4.35	-7.13	-22.90
260	27.00	21.40	15.60	-5.80	-8.40	-11.90	29.44	25.64	9.76	-4.35	-7.12	-22.96
265	27.00	21.30	15.50	-5.80	-8.50	-12.00	29.44	25.64	9.69	-4.35	-7.12	-23.03
270	27.00	21.40	15.40	-5.80	-8.40	-12.10	29.44	25.64	9.63	-4.35	-7.12	-23.09
275	26.90	21.40	15.20	-5.90	-8.40	-12.30	29.44	25.64	9.57	-4.35	-7.12	-23.15
280	26.90	21.40	15.20	-5.90	-8.40	-12.30	29.43	25.64	9.52	-4.36	-7.12	-23.20
285	26.90	21.10	15.10	-5.90	-8.70	-12.40	29.43	25.65	9.47	-4.36	-7.11	-23.25
290	26.90	20.90	15.10	-5.90	-8.90	-12.40	29.43	25.65	9.42	-4.36	-7.11	-23.30
295	26.80	20.90	15.10	-6.00	-8.90	-12.40	29.43	25.65	9.37	-4.36	-7.11	-23.35
300	26.80	20.90	15.30	-6.00	-8.90	-12.20	29.43	25.65	9.33	-4.36	-7.11	-23.39

TABLE A46 (con'd). Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

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HUMAN SUBJECT No.: 4				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 4					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME min	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
		left	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	32.40	32.10	32.60	0.00	0.00	0.00	34.75	33.61	32.98	0.00	0.00	0.00
5	31.90	30.80	31.70	-0.50	-1.30	-0.90	33.21	30.60	30.20	-1.54	-3.01	-2.78
10	31.60	30.10	31.20	-0.80	-2.00	-1.40	32.39	29.48	29.34	-2.36	-4.13	-3.64
15	31.30	29.60	30.80	-1.10	-2.50	-1.80	31.84	28.78	28.81	-2.91	-4.83	-4.17
20	30.90	29.00	30.40	-1.50	-3.10	-2.20	31.24	28.28	28.40	-3.51	-5.33	-4.58
25	30.60	28.60	29.90	-1.80	-3.50	-2.70	30.76	27.89	28.05	-3.99	-5.72	-4.93
30	30.30	28.20	29.80	-2.10	-3.90	-2.80	30.38	27.60	27.75	-4.37	-6.01	-5.23
35	29.90	27.70	29.10	-2.50	-4.40	-3.50	30.09	27.37	27.47	-4.66	-6.24	-5.51
40	29.60	27.30	28.70	-2.80	-4.80	-3.90	29.83	27.18	27.20	-4.92	-6.43	-5.78
45	29.20	26.90	28.30	-3.20	-5.20	-4.30	29.62	27.01	26.95	-5.13	-6.60	-6.03
50	28.90	26.50	27.90	-3.50	-5.60	-4.70	29.44	26.87	26.71	-5.31	-6.74	-6.27
55	28.70	26.20	27.50	-3.70	-5.90	-5.10	29.28	26.75	26.48	-5.47	-6.86	-6.50
60	28.50	25.90	27.10	-3.90	-6.20	-5.50	29.15	26.63	26.25	-5.60	-6.98	-6.73
65	28.20	25.60	26.80	-4.20	-6.50	-5.80	29.03	26.54	26.03	-5.72	-7.07	-6.95
70	28.10	25.30	26.40	-4.30	-6.80	-6.20	28.93	26.45	25.82	-5.82	-7.16	-7.16
75	27.90	25.10	26.00	-4.50	-7.00	-6.60	28.84	26.37	25.61	-5.91	-7.24	-7.37
80	27.80	24.80	25.60	-4.60	-7.30	-7.00	28.77	26.30	25.42	-5.98	-7.31	-7.56
85	27.70	24.70	25.20	-4.70	-7.40	-7.40	28.70	26.24	25.23	-6.05	-7.37	-7.75
90	27.60	24.50	24.90	-4.80	-7.60	-7.70	28.64	26.18	25.04	-6.11	-7.43	-7.94
95	27.60	24.40	24.50	-4.80	-7.70	-8.10	28.59	26.13	24.86	-6.16	-7.48	-8.12
100	27.60	24.40	24.10	-4.80	-7.70	-8.50	28.55	26.08	24.69	-6.20	-7.53	-8.29
105	27.60	24.60	23.70	-4.80	-7.50	-8.90	28.52	26.04	24.52	-6.23	-7.57	-8.46
110	27.60	24.70	23.40	-4.80	-7.40	-9.20	28.49	26.00	24.36	-6.26	-7.61	-8.62
115	27.50	24.80	23.10	-4.90	-7.30	-9.50	28.46	25.96	24.20	-6.29	-7.65	-8.78
120	27.60	24.90	22.80	-4.80	-7.20	-9.80	28.44	25.93	24.05	-6.31	-7.68	-8.93
125	27.60	25.00	22.50	-4.80	-7.10	-10.10	28.42	25.90	23.90	-6.33	-7.71	-9.08
130	27.60	25.10	22.20	-4.80	-7.00	-10.40	28.41	25.87	23.76	-6.34	-7.74	-9.22
135	27.50	25.20	22.00	-4.90	-6.90	-10.60	28.40	25.84	23.63	-6.35	-7.77	-9.35
140	27.50	25.30	21.80	-4.90	-6.80	-10.80	28.39	25.82	23.50	-6.36	-7.79	-9.48
145	27.60	25.40	21.60	-4.80	-6.70	-11.00	28.39	25.80	23.37	-6.36	-7.81	-9.61
150	27.50	25.50	21.50	-4.90	-6.60	-11.10	28.39	25.78	23.25	-6.36	-7.83	-9.73

TABLE A47. Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 4				SEX: Male			MODEL PREDICTIONS for SUBJECT No.: 4					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
min		left	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
155	27.50	25.60	21.30	-4.90	-6.50	-11.30	28.38	25.76	23.14	-6.37	-7.85	-9.84
160	27.50	25.80	21.30	-4.90	-6.30	-11.30	28.38	25.75	23.03	-6.37	-7.86	-9.95
165	27.50	25.70	21.30	-4.90	-6.40	-11.30	28.39	25.73	22.92	-6.36	-7.88	-10.06
170	27.30	25.70	21.10	-5.10	-6.40	-11.50	28.39	25.72	22.82	-6.36	-7.89	-10.16
175	27.20	25.80	21.00	-5.20	-6.30	-11.60	28.39	25.70	22.72	-6.36	-7.91	-10.26
180	27.20	5.90	21.10	-5.20	-6.20	-11.50	28.39	25.69	22.63	-6.36	-7.92	-10.35
185	27.20	25.90	21.00	-5.20	-6.20	-11.60	28.40	25.68	22.54	-6.35	-7.93	-10.44
190	27.10	25.90	21.10	-5.30	-6.20	-11.50	28.40	25.67	22.45	-6.35	-7.94	-10.53
195	27.10	25.90	21.10	-5.30	-6.20	-11.50	28.40	25.66	22.37	-6.35	-7.95	-10.61
200	27.10	25.80	21.00	-5.30	-6.30	-11.60	28.41	25.65	22.29	-6.34	-7.96	-10.69
205	27.20	25.80	20.90	-5.20	-6.30	-11.70	28.41	25.64	22.21	-6.34	-7.97	-10.77
210	27.10	25.80	20.80	-5.30	-6.30	-11.80	28.41	25.63	22.13	-6.34	-7.98	-10.85
215	27.10	25.80	20.80	-5.30	-6.30	-11.80	28.42	25.63	22.07	-6.33	-7.98	-10.91
220	27.00	25.70	21.10	-5.40	-6.40	-11.50	28.42	25.62	22.00	-6.33	-7.99	-10.98
225	27.20	25.50	21.30	-5.20	-6.60	-11.30	28.43	25.61	21.93	-6.32	-8.00	-11.05
230	27.40	25.40	21.40	-5.00	-6.70	-11.20	28.43	25.61	21.87	-6.32	-8.00	-11.11
235	27.30	25.30	21.20	-5.10	-6.80	-11.40	28.43	25.60	21.81	-6.32	-8.01	-11.17
240	27.20	25.40	21.20	-5.20	-6.70	-11.40	28.44	25.59	21.75	-6.31	-8.02	-11.23
245	27.20	25.40	21.20	-5.20	-6.70	-11.40	28.44	25.59	21.70	-6.31	-8.02	-11.28
250	27.10	25.40	21.20	-5.30	-6.70	-11.40	28.44	25.58	21.64	-6.31	-8.03	-11.34
255	27.10	25.40	21.30	-5.30	-6.70	-11.30	28.44	25.58	21.59	-6.31	-8.03	-11.39
260	27.10	25.40	21.40	-5.30	-6.70	-11.20	28.45	25.57	21.54	-6.30	-8.04	-11.44
265	27.10	25.40	21.50	-5.30	-6.70	-11.10	28.45	25.57	21.49	-6.30	-8.04	-11.49
270	27.10	25.40	21.40	-5.30	-6.70	-11.20	28.45	25.56	21.45	-6.30	-8.05	-11.53
275	27.00	25.30	21.40	-5.40	-6.80	-11.20	28.45	25.56	21.40	-6.30	-8.05	-11.58
280	27.00	25.20	21.70	-5.40	-6.90	-10.90	28.45	25.55	21.36	-6.30	-8.06	-11.62
285	26.90	25.30	21.60	-5.50	-6.80	-11.00	28.46	25.55	21.32	-6.29	-8.06	-11.66
290	26.80	25.20	21.70	-5.60	-6.90	-10.90	28.46	25.55	21.28	-6.29	-8.06	-11.70
295	26.80	25.20	21.80	-5.60	-6.90	-10.80	28.46	25.54	21.25	-6.29	-8.07	-11.73
300	26.80	25.10	21.80	-5.60	-7.00	-10.80	28.46	25.54	21.21	-6.29	-8.07	-11.77

TABLE A47 (con'd). Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 2				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 2					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND	CHEST	ARM	HAND	CHEST	ARM	HAND
min		right	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	33.70	33.20	30.90	0.00	0.00	0.00	33.79	32.75	32.70	0.00	0.00	0.00
5	33.10	32.80	30.00	-0.60	-0.40	-0.90	31.35	29.19	29.04	-2.44	-3.56	-3.66
10	32.30	32.10	29.90	-1.40	-1.10	-1.00	30.86	27.86	27.54	-2.93	-4.89	-5.16
15	31.60	31.60	29.30	-2.10	-1.60	-1.60	30.21	26.81	26.29	-3.58	-5.94	-6.41
20	31.00	31.10	28.60	-2.70	-2.10	-2.30	29.62	26.01	25.22	-4.17	-6.74	-7.48
25	30.60	30.60	27.60	-3.10	-2.60	-3.30	29.44	25.53	24.22	-4.35	-7.22	-8.48
30	30.10	29.80	26.80	-3.60	-3.40	-4.10	29.54	25.37	23.29	-4.25	-7.38	-9.41
35	30.00	29.40	25.70	-3.70	-3.80	-5.20	29.68	25.36	22.44	-4.11	-7.39	-10.26
40	29.80	28.90	24.30	-3.90	-4.30	-6.60	29.77	25.35	21.61	-4.02	-7.40	-11.09
45	29.90	29.40	24.10	-3.80	-3.80	-6.80	29.84	25.36	20.84	-3.95	-7.39	-11.86
50	29.70	29.50	23.70	-4.00	-3.70	-7.20	29.89	25.37	20.13	-3.90	-7.38	-12.57
55	29.50	29.80	22.40	-4.20	-3.40	-8.50	29.93	25.39	19.44	-3.86	-7.36	-13.26
60	29.30	29.20	22.20	-4.40	-4.00	-8.70	29.96	25.43	18.79	-3.83	-7.32	-13.91
65	29.10	28.30	21.00	-4.60	-4.90	-9.90	29.98	25.47	18.18	-3.81	-7.28	-14.52
70	28.90	28.30	20.20	-4.80	-4.90	-10.70	30.00	25.51	17.60	-3.79	-7.24	-15.10
75	28.70	27.60	20.10	-5.00	-5.60	-10.80	30.02	25.57	17.04	-3.77	-7.18	-15.66
80	28.70	27.20	19.20	-5.00	-6.00	-11.70	30.04	25.62	16.53	-3.75	-7.13	-16.17
85	28.60	27.20	19.00	-5.10	-6.00	-11.90	30.05	25.67	16.03	-3.74	-7.08	-16.67
90	28.60	26.90	17.70	-5.10	-6.30	-13.20	30.05	25.72	15.56	-3.74	-7.03	-17.14
95	28.60	26.20	17.20	-5.10	-7.00	-13.70	30.06	25.77	15.13	-3.73	-6.98	-17.57
100	28.80	26.30	16.80	-4.90	-6.90	-14.10	30.07	25.82	14.70	-3.72	-6.93	-18.00
105	28.80	26.10	15.90	-4.90	-7.10	-15.00	30.07	25.86	14.31	-3.72	-6.89	-18.39
110	28.80	26.10	15.60	-4.90	-7.10	-15.30	30.07	25.89	13.95	-3.72	-6.86	-18.75
115	28.80	25.90	15.80	-4.90	-7.30	-15.10	30.08	25.93	13.60	-3.71	-6.82	-19.10
120	28.70	25.70	15.50	-5.00	-7.50	-15.40	30.08	25.96	13.27	-3.71	-6.79	-19.43
125	28.60	25.30	15.00	-5.10	-7.90	-15.90	30.08	25.98	12.98	-3.71	-6.77	-19.72
130	28.40	25.00	14.80	-5.30	-8.20	-16.10	30.08	26.01	12.69	-3.71	-6.74	-20.01
135	28.20	24.40	14.50	-5.50	-8.80	-16.40	30.08	26.03	12.42	-3.71	-6.72	-20.28
140	28.30	24.00	14.00	-5.40	-9.20	-16.90	30.08	26.05	12.17	-3.71	-6.70	-20.53
145	28.40	23.70	14.30	-5.30	-9.50	-16.60	30.09	26.07	11.94	-3.70	-6.68	-20.76
150	28.50	23.30	14.00	-5.20	-9.90	-16.90	30.09	26.08	11.72	-3.70	-6.67	-20.98

TABLE A48. Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 2				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 2					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND	CHEST	ARM	HAND	CHEST	ARM	HAND
min	right left			right left								
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
155	28.90	23.10	13.70	-4.80	-10.10	-17.20	30.09	26.10	11.51	-3.70	-6.65	-21.19
160	28.90	23.10	13.70	-4.80	-10.10	-17.20	30.09	26.11	11.32	-3.70	-6.64	-21.38
165	29.10	23.20	14.00	-4.60	-10.00	-16.90	30.09	26.12	11.13	-3.70	-6.63	-21.57
170	29.10	22.90	13.60	-4.60	-10.30	-17.30	30.09	26.13	10.97	-3.70	-6.62	-21.73
175	29.20	22.70	13.70	-4.50	-10.50	-17.20	30.10	26.14	10.81	-3.69	-6.61	-21.89
180	29.20	23.10	13.60	-4.50	-10.10	-17.30	30.10	26.15	10.66	-3.69	-6.60	-22.04
185	29.20	22.90	13.30	-4.50	-10.30	-17.60	30.10	26.15	10.52	-3.69	-6.60	-22.18
190	29.20	22.80	13.00	-4.50	-10.40	-17.90	30.10	26.16	10.39	-3.69	-6.59	-22.31
195	29.20	22.70	12.80	-4.50	-10.50	-18.10	30.10	26.17	10.26	-3.69	-6.58	-22.44
200	29.20	22.40	12.80	-4.50	-10.80	-18.10	30.10	26.17	10.15	-3.69	-6.58	-22.55
205	29.10	22.30	12.60	-4.60	-10.90	-18.30	30.11	26.18	10.04	-3.68	-6.57	-22.66
210	29.20	22.60	12.80	-4.50	-10.60	-18.10	30.11	26.18	9.94	-3.68	-6.57	-22.76
215	29.20	22.70	12.90	-4.50	-10.50	-18.00	30.11	26.19	9.84	-3.68	-6.56	-22.86
220	29.00	22.40	13.00	-4.70	-10.80	-17.90	30.11	26.19	9.75	-3.68	-6.56	-22.95
225	28.90	22.10	13.20	-4.80	-11.10	-17.70	30.11	26.20	9.67	-3.68	-6.55	-23.03
230	28.80	21.90	12.90	-4.90	-11.30	-18.00	30.11	26.20	9.59	-3.68	-6.55	-23.11
235	29.00	21.60	12.60	-4.70	-11.60	-18.30	30.11	26.20	9.52	-3.68	-6.55	-23.18
240	29.10	21.50	12.80	-4.60	-11.70	-18.10	30.11	26.21	9.45	-3.68	-6.54	-23.25
245	29.30	21.30	12.60	-4.40	-11.90	-18.30	30.12	26.21	9.39	-3.67	-6.54	-23.31
250	29.30	21.10	12.70	-4.40	-12.10	-18.20	30.12	26.21	9.33	-3.67	-6.54	-23.37
255	29.20	21.30	12.50	-4.50	-11.90	-18.40	30.12	26.21	9.27	-3.67	-6.54	-23.43
260	29.30	21.20	12.70	-4.40	-12.00	-18.20	30.12	26.22	9.22	-3.67	-6.53	-23.48
265	29.30	21.40	12.60	-4.40	-11.80	-18.30	30.12	26.22	9.17	-3.67	-6.53	-23.53
270	29.30	21.50	13.10	-4.40	-11.70	-17.80	30.12	26.22	9.12	-3.67	-6.53	-23.58
275	29.50	21.50	12.90	-4.20	-11.70	-18.00	30.12	26.22	9.08	-3.67	-6.53	-23.62
280	29.40	21.30	12.80	-4.30	-11.90	-18.10	30.12	26.22	9.03	-3.67	-6.53	-23.67
285	29.30	21.10	12.90	-4.40	-12.10	-18.00	30.12	26.22	9.00	-3.67	-6.53	-23.70
290	29.50	20.90	12.50	-4.20	-12.30	-18.40	30.12	26.23	8.96	-3.67	-6.52	-23.74
295	29.60	21.30	12.40	-4.10	-11.90	-18.50	30.12	26.23	8.93	-3.67	-6.52	-23.77
300	29.70	21.40	12.30	-4.00	-11.80	-18.60	30.12	26.23	8.89	-3.67	-6.52	-23.81

TABLE A48 (con'd). Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 2				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 2					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
min		left	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	35.90	31.40	29.90	0.00	0.00	0.00	34.75	33.61	32.98	0.00	0.00	0.00
5	35.80	31.10	29.70	-0.10	-0.30	-0.20	33.18	30.53	30.11	-1.57	-3.08	-2.87
10	36.00	30.90	29.30	0.10	-0.50	-0.60	32.86	29.42	29.25	-1.89	-4.19	-3.73
15	35.80	30.60	28.70	-0.10	-0.80	-1.20	32.33	28.68	28.67	-2.42	-4.93	-4.31
20	35.60	30.20	28.10	-0.30	-1.20	-1.80	31.60	28.14	28.23	-3.15	-5.47	-4.75
25	35.50	29.90	27.60	-0.40	-1.50	-2.30	31.04	27.72	27.85	-3.71	-5.89	-5.13
30	35.40	29.60	27.20	-0.50	-1.80	-2.70	30.62	27.45	27.52	-4.13	-6.16	-5.46
35	35.30	29.30	26.80	-0.60	-2.10	-3.10	30.31	27.25	27.23	-4.44	-6.36	-5.75
40	35.20	28.80	26.40	-0.70	-2.60	-3.50	30.05	27.08	26.96	-4.70	-6.53	-6.02
45	35.20	28.50	26.10	-0.70	-2.90	-3.80	29.84	26.94	26.70	-4.91	-6.67	-6.28
50	35.10	28.30	25.70	-0.80	-3.10	-4.20	29.67	26.83	26.45	-5.08	-6.78	-6.53
55	35.00	28.00	25.40	-0.90	-3.40	-4.50	29.52	26.72	26.21	-5.23	-6.89	-6.77
60	34.90	27.70	25.10	-1.00	-3.70	-4.80	29.40	26.64	25.99	-5.35	-6.97	-6.99
65	34.80	27.70	24.70	-1.10	-3.70	-5.20	29.30	26.56	25.77	-5.45	-7.05	-7.21
70	34.70	27.50	24.40	-1.20	-3.90	-5.50	29.21	26.50	25.56	-5.54	-7.11	-7.42
75	34.70	27.50	24.10	-1.20	-3.90	-5.80	29.14	26.45	25.36	-5.61	-7.16	-7.62
80	34.60	27.60	23.80	-1.30	-3.80	-6.10	29.08	26.40	25.18	-5.67	-7.21	-7.80
85	34.60	27.60	23.60	-1.30	-3.80	-6.30	29.03	26.36	24.99	-5.72	-7.25	-7.99
90	34.50	27.20	23.30	-1.40	-4.20	-6.60	28.99	26.33	24.82	-5.76	-7.28	-8.16
95	34.30	27.80	23.00	-1.60	-4.50	-6.90	28.96	26.30	24.66	-5.79	-7.31	-8.32
100	34.30	27.70	22.70	-1.60	-3.70	-7.20	28.94	26.28	24.50	-5.81	-7.33	-8.48
105	34.20	27.60	22.40	-1.70	-3.80	-7.50	28.92	26.26	24.35	-5.83	-7.35	-8.63
110	34.20	27.50	22.10	-1.70	-3.90	-7.80	28.91	26.24	24.21	-5.84	-7.37	-8.77
115	34.10	27.40	21.90	-1.80	-4.00	-8.00	28.90	26.23	24.07	-5.85	-7.38	-8.91
120	34.10	27.40	21.70	-1.80	-4.00	-8.20	28.90	26.21	23.94	-5.85	-7.40	-9.04
125	34.10	27.40	21.50	-1.80	-4.00	-8.40	28.89	26.20	23.82	-5.86	-7.41	-9.16
130	34.10	27.60	21.30	-1.80	-3.80	-8.60	28.90	26.19	23.70	-5.85	-7.42	-9.28
135	34.10	27.60	21.10	-1.80	-3.80	-8.80	28.90	26.18	23.59	-5.85	-7.43	-9.39
140	34.10	27.50	20.90	-1.80	-3.90	-9.00	28.90	26.18	23.49	-5.85	-7.43	-9.49
145	34.10	27.50	20.70	-1.80	-3.90	-9.20	28.91	26.17	23.38	-5.84	-7.44	-9.60
150	34.00	27.50	20.50	-1.90	-3.90	-9.40	28.92	26.16	23.29	-5.83	-7.45	-9.69

TABLE A49. Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 2				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 2					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME min	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
		left	left		right	left						
		(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)	
<hr/>												
155	34.00	27.30	20.30	-1.90	-4.10	-9.60	28.92	26.16	23.20	-5.83	-7.45	-9.78
160	34.00	27.30	20.30	-1.90	-4.10	-9.60	28.93	26.15	23.11	-5.82	-7.46	-9.87
165	33.90	27.10	20.20	-2.00	-4.30	-9.70	28.94	26.15	23.03	-5.81	-7.46	-9.95
170	34.00	26.90	20.00	-1.90	-4.50	-9.90	28.95	26.14	22.95	-5.80	-7.47	-10.03
175	34.00	26.80	20.00	-1.90	-4.60	-9.90	28.96	26.14	22.87	-5.79	-7.47	-10.11
180	34.10	27.00	19.80	-1.80	-4.40	-10.10	28.96	26.13	22.80	-5.79	-7.48	-10.18
185	34.20	27.00	19.60	-1.70	-4.40	-10.30	28.97	26.13	22.73	-5.78	-7.48	-10.25
190	34.20	27.10	19.50	-1.70	-4.30	-10.40	28.98	26.13	22.67	-5.77	-7.48	-10.31
195	34.20	27.00	19.40	-1.70	-4.40	-10.50	28.99	26.13	22.61	-5.76	-7.48	-10.37
200	34.20	26.90	19.20	-1.70	-4.50	-10.70	28.99	26.12	22.55	-5.76	-7.49	-10.43
205	34.20	27.10	19.10	-1.70	-4.30	-10.80	29.00	26.12	22.49	-5.75	-7.49	-10.49
210	34.30	27.10	19.00	-1.60	-4.30	-10.90	29.01	26.12	22.44	-5.74	-7.49	-10.54
215	34.30	27.00	18.90	-1.60	-4.40	-11.00	29.01	26.12	22.39	-5.74	-7.49	-10.59
220	34.20	25.30	18.80	-1.70	-6.10	-11.10	29.02	26.11	22.34	-5.73	-7.50	-10.64
225	34.20	26.70	18.80	-1.70	-4.70	-11.10	29.02	26.11	22.29	-5.73	-7.50	-10.69
230	34.20	26.60	18.80	-1.70	-4.80	-11.10	29.03	26.11	22.25	-5.72	-7.50	-10.73
235	34.20	26.60	18.80	-1.70	-4.80	-11.10	29.04	26.11	22.20	-5.71	-7.50	-10.78
240	34.20	26.30	18.60	-1.70	-5.10	-11.30	29.04	26.11	22.16	-5.71	-7.50	-10.82
245	34.20	26.00	18.70	-1.70	-5.40	-11.20	29.04	26.11	22.12	-5.71	-7.50	-10.86
250	34.20	25.60	18.60	-1.70	-5.80	-11.30	29.05	26.10	22.09	-5.70	-7.51	-10.89
255	34.20	25.80	18.70	-1.70	-5.60	-11.20	29.05	26.10	22.05	-5.70	-7.51	-10.93
260	34.20	25.60	18.70	-1.70	-5.80	-11.20	29.06	26.10	22.02	-5.69	-7.51	-10.96
265	34.30	26.40	18.70	-1.60	-7.00	-11.20	29.06	26.10	21.98	-5.69	-7.51	-11.00
270	34.30	25.10	18.60	-1.60	-6.30	-11.30	29.06	26.10	21.95	-5.69	-7.51	-11.03
275	34.30	25.40	18.60	-1.60	-6.00	-11.30	29.07	26.10	21.92	-5.68	-7.51	-11.06
280	34.30	25.40	18.60	-1.60	-6.00	-11.30	29.07	26.10	21.89	-5.68	-7.51	-11.09
285	34.30	25.10	18.50	-1.60	-6.30	-11.40	29.07	26.10	21.87	-5.68	-7.51	-11.11
290	34.30	25.10	18.50	-1.60	-6.30	-11.40	29.08	26.09	21.84	-5.67	-7.52	-11.14
295	34.40	26.70	18.40	-1.50	-6.70	-11.50	29.08	26.09	21.82	-5.67	-7.52	-11.16
300	34.50	26.60	18.40	-1.40	-6.80	-11.50	29.08	26.09	21.79	-5.67	-7.52	-11.19

TABLE A49 (con'd). Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 5				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 5					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME min	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND	CHEST	ARM	HAND	CHEST	ARM	HAND
		right	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	34.30	32.80	30.30	0.00	0.00	0.00	33.80	32.75	32.70	0.00	0.00	0.00
5	33.50	33.00	30.80	-0.80	0.20	0.50	31.86	29.51	29.03	-1.94	-3.24	-3.67
10	33.00	33.10	30.50	-1.30	0.30	0.20	31.72	28.43	27.55	-2.08	-4.32	-5.15
15	32.60	33.30	30.20	-1.70	0.50	-0.10	31.32	27.51	26.33	-2.48	-5.24	-6.37
20	32.10	33.20	29.50	-2.20	0.40	-0.80	30.75	26.68	25.21	-3.05	-6.07	-7.49
25	31.90	33.00	28.80	-2.40	0.20	-1.50	30.34	26.05	24.17	-3.46	-6.70	-8.53
30	31.70	32.80	28.00	-2.60	0.00	-2.30	30.37	25.83	23.21	-3.43	-6.92	-9.49
35	31.30	32.90	27.40	-3.00	0.10	-2.90	30.61	25.93	22.33	-3.19	-6.82	-10.37
40	31.30	32.30	27.40	-3.00	-0.50	-2.90	30.88	26.19	21.48	-2.92	-6.56	-11.22
45	31.50	32.00	27.80	-2.80	-0.80	-2.50	31.33	26.52	20.68	-2.47	-6.23	-12.02
50	31.50	31.60	27.60	-2.80	-1.20	-2.70	31.26	26.83	19.95	-2.54	-5.92	-12.75
55	31.30	31.70	27.00	-3.00	-1.10	-3.30	31.35	27.09	19.25	-2.45	-5.66	-13.45
60	31.10	31.40	26.20	-3.20	-1.40	-4.10	31.39	27.29	18.58	-2.41	-5.46	-14.12
65	31.30	31.30	25.80	-3.00	-1.50	-4.50	31.41	27.44	17.97	-2.39	-5.31	-14.73
70	31.20	31.30	25.20	-3.10	-1.50	-5.10	31.43	27.56	17.38	-2.37	-5.19	-15.32
75	31.10	31.20	26.00	-3.20	-1.60	-4.30	31.43	27.66	16.82	-2.37	-5.09	-15.88
80	31.00	31.00	25.80	-3.30	-1.80	-4.50	31.44	27.73	16.31	-2.36	-5.02	-16.39
85	31.00	31.10	25.80	-3.30	-1.70	-4.50	31.44	27.80	15.81	-2.36	-4.95	-16.89
90	30.90	30.50	25.20	-3.40	-2.30	-5.10	31.45	27.85	15.34	-2.35	-4.90	-17.36
95	30.90	30.00	24.60	-3.40	-2.80	-5.70	31.45	27.90	14.91	-2.35	-4.85	-17.79
100	31.20	30.10	24.50	-3.10	-2.70	-5.80	31.45	27.94	14.49	-2.35	-4.81	-18.21
105	31.20	30.00	23.90	-3.10	-2.80	-6.40	31.45	27.97	14.09	-2.35	-4.78	-18.61
110	31.10	29.50	23.80	-3.20	-3.30	-6.50	31.46	28.00	13.72	-2.34	-4.75	-18.98
115	30.90	29.20	24.20	-3.40	-3.60	-6.10	31.46	28.02	13.36	-2.34	-4.73	-19.34
120	30.80	29.00	24.20	-3.50	-3.80	-6.10	31.46	28.04	13.02	-2.34	-4.71	-19.68
125	30.90	28.70	23.80	-3.40	-4.10	-6.50	31.47	28.06	12.72	-2.33	-4.69	-19.98
130	30.90	28.60	22.80	-3.40	-4.20	-7.50	31.47	28.07	12.42	-2.33	-4.68	-20.28
135	30.80	28.30	22.70	-3.50	-4.50	-7.60	31.48	28.09	12.14	-2.32	-4.66	-20.56
140	30.90	28.20	22.50	-3.40	-4.60	-7.80	31.48	28.10	11.89	-2.32	-4.65	-20.81
145	30.90	28.10	22.20	-3.40	-4.70	-8.10	31.48	28.11	11.65	-2.32	-4.64	-21.05
150	30.80	27.80	22.00	-3.50	-5.00	-8.30	31.49	28.12	11.42	-2.31	-4.63	-21.28

TABLE A50. Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 5				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 5					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	SHOULDER	ARM	HAND	SHOULDER	ARM	HAND	CHEST	ARM	HAND	CHEST	ARM	HAND
min	right left			right left								
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
155	31.20	27.70	21.80	-3.10	-5.10	-8.50	31.49	28.13	11.21	-2.31	-4.62	-21.49
160	31.30	27.50	21.10	-3.00	-5.30	-9.20	31.50	28.14	11.02	-2.30	-4.61	-21.68
165	31.30	27.50	20.90	-3.00	-5.30	-9.40	31.50	28.14	10.83	-2.30	-4.61	-21.87
170	31.40	27.40	21.00	-2.90	-5.40	-9.30	31.50	28.15	10.66	-2.30	-4.60	-22.04
175	31.20	27.50	20.90	-3.10	-5.30	-9.40	31.51	28.16	10.50	-2.29	-4.59	-22.20
180	31.00	27.30	20.50	-3.30	-5.50	-9.80	31.51	28.16	10.35	-2.29	-4.59	-22.35
185	31.00	27.20	19.90	-3.30	-5.60	-10.40	31.51	28.17	10.21	-2.29	-4.58	-22.49
190	31.00	26.90	19.80	-3.30	-5.90	-10.50	31.52	28.17	10.08	-2.28	-4.58	-22.62
195	31.10	26.80	19.70	-3.20	-6.00	-10.60	31.52	28.18	9.96	-2.28	-4.57	-22.74
200	31.30	26.80	19.00	-3.00	-6.00	-11.30	31.52	28.18	9.84	-2.28	-4.57	-22.86
205	31.40	26.70	18.40	-2.90	-6.10	-11.90	31.53	28.19	9.74	-2.27	-4.56	-22.96
210	31.60	26.50	18.20	-2.70	-6.30	-12.10	31.53	28.19	9.64	-2.27	-4.56	-23.06
215	31.50	26.10	18.00	-2.80	-6.70	-12.30	31.53	28.19	9.54	-2.27	-4.56	-23.16
220	31.50	26.00	17.80	-2.80	-6.80	-12.50	31.53	28.20	9.46	-2.27	-4.55	-23.24
225	31.50	25.90	17.20	-2.80	-6.90	-13.10	31.54	28.20	9.37	-2.26	-4.55	-23.33
230	31.40	25.80	17.00	-2.90	-7.00	-13.30	31.54	28.20	9.30	-2.26	-4.55	-23.40
235	31.40	25.70	16.90	-2.90	-7.10	-13.40	31.54	28.20	9.23	-2.26	-4.55	-23.47
240	31.40	25.60	16.80	-2.90	-7.20	-13.50	31.54	28.21	9.16	-2.26	-4.54	-23.54
245	31.30	25.90	16.20	-3.00	-6.90	-14.10	31.54	28.21	9.10	-2.26	-4.54	-23.60
250	31.20	25.70	16.00	-3.10	-7.10	-14.30	31.54	28.21	9.04	-2.26	-4.54	-23.66
255	31.30	25.30	15.80	-3.00	-7.50	-14.50	31.55	28.21	8.99	-2.25	-4.54	-23.71
260	31.20	25.80	15.60	-3.10	-7.00	-14.70	31.55	28.21	8.94	-2.25	-4.54	-23.76
265	31.20	25.80	15.00	-3.10	-7.00	-15.30	31.55	28.22	8.89	-2.25	-4.53	-23.81
270	31.20	25.90	14.90	-3.10	-6.90	-15.40	31.55	28.22	8.85	-2.25	-4.53	-23.85
275	31.20	26.00	14.80	-3.10	-6.80	-15.50	31.55	28.22	8.80	-2.25	-4.53	-23.90
280	31.20	26.00	14.50	-3.10	-6.80	-15.80	31.55	28.22	8.77	-2.25	-4.53	-23.93
285	31.30	25.90	14.00	-3.00	-6.90	-16.30	31.55	28.22	8.73	-2.25	-4.53	-23.97
290	31.30	25.50	13.60	-3.00	-7.30	-16.70	31.55	28.22	8.70	-2.25	-4.53	-24.00
295	31.40	25.20	13.40	-2.90	-7.60	-16.90	31.55	28.22	8.66	-2.25	-4.53	-24.04
300	31.50	25.00	13.20	-2.80	-7.80	-17.10	31.55	28.23	8.63	-2.25	-4.52	-24.07

TABLE A50 (con'd). Comparison of human shoulder, arm and hand temperatures (degrees C) from Pelapu 4 with Model predictions. Estimates of chest temperature were compared to human shoulder data. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 5				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 5					
SUIT: BAYLEY IMMERSION				WATER TEMP: 32 deg F								
TIME	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
min		left	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
0	33.80	31.00	32.00	0.00	0.00	0.00	34.75	33.61	32.98	0.00	0.00	0.00
5	34.00	30.40	31.50	0.20	-0.60	-0.50	33.32	31.15	30.89	-1.43	-2.46	-2.09
10	34.10	30.00	30.70	0.30	-1.00	-1.30	33.36	30.45	30.35	-1.39	-3.16	-2.63
15	34.10	29.70	30.00	0.30	-1.30	-2.00	33.07	29.94	29.92	-1.68	-3.67	-3.06
20	33.90	29.30	29.50	0.10	-1.70	-2.50	32.52	29.52	29.52	-2.23	-4.09	-3.46
25	33.70	28.80	29.00	-0.10	-2.20	-3.00	31.86	29.19	29.15	-2.89	-4.42	-3.83
30	33.40	28.50	28.50	-0.40	-2.50	-3.50	31.44	29.00	28.82	-3.31	-4.61	-4.16
35	32.90	27.80	27.80	-0.90	-3.20	-4.20	31.17	28.91	28.54	-3.58	-4.70	-4.44
40	32.90	27.20	27.50	-0.90	-3.80	-4.50	30.98	28.86	28.26	-3.77	-4.75	-4.72
45	32.50	26.80	27.00	-1.30	-4.20	-5.00	30.85	28.85	28.00	-3.90	-4.76	-4.98
50	32.40	26.50	26.80	-1.40	-4.50	-5.20	30.77	28.86	27.75	-3.98	-4.75	-5.23
55	32.10	26.20	26.10	-1.70	-4.80	-5.90	30.71	28.86	27.51	-4.04	-4.75	-5.47
60	32.00	25.90	25.90	-1.80	-5.10	-6.10	30.67	28.86	27.29	-4.08	-4.75	-5.69
65	31.90	25.50	25.50	-1.90	-5.50	-6.50	30.64	28.86	27.08	-4.11	-4.75	-5.90
70	31.80	25.30	25.00	-2.00	-5.70	-7.00	30.62	28.86	26.87	-4.13	-4.75	-6.11
75	31.50	25.20	24.80	-2.30	-5.80	-7.20	30.61	28.85	26.68	-4.14	-4.76	-6.30
80	31.40	25.10	24.30	-2.40	-5.90	-7.70	30.61	28.85	26.50	-4.14	-4.76	-6.48
85	31.30	25.00	24.00	-2.50	-6.00	-8.00	30.62	28.85	26.33	-4.13	-4.76	-6.65
90	31.10	25.00	23.90	-2.70	-6.00	-8.10	30.63	28.85	26.17	-4.12	-4.76	-6.81
95	31.00	25.10	23.40	-2.80	-5.90	-8.60	30.65	28.85	26.02	-4.10	-4.76	-6.96
100	30.90	25.20	23.50	-2.90	-5.80	-8.50	30.66	28.85	25.87	-4.09	-4.76	-7.11
105	30.90	25.50	23.30	-2.90	-5.50	-8.70	30.68	28.86	25.74	-4.07	-4.75	-7.24
110	30.80	25.40	23.00	-3.00	-5.60	-9.00	30.70	28.86	25.61	-4.05	-4.75	-7.37
115	30.90	25.30	23.00	-2.90	-5.70	-9.00	30.72	28.86	25.49	-4.03	-4.75	-7.49
120	30.90	25.20	23.10	-2.90	-5.80	-8.90	30.74	28.86	25.38	-4.01	-4.75	-7.60
125	31.00	25.10	23.10	-2.80	-5.90	-8.90	30.76	28.86	25.27	-3.99	-4.75	-7.71
130	31.10	25.30	23.00	-2.70	-5.70	-9.00	30.78	28.86	25.17	-3.97	-4.75	-7.81
135	31.10	25.30	22.90	-2.70	-5.70	-9.10	30.80	28.86	25.08	-3.95	-4.75	-7.90
140	31.00	25.40	22.90	-2.80	-5.60	-9.10	30.82	28.87	24.99	-3.93	-4.74	-7.99
145	31.00	25.30	22.90	-2.80	-5.70	-9.10	30.83	28.87	24.90	-3.92	-4.74	-8.08
150	30.90	25.40	23.00	-2.90	-5.60	-9.00	30.85	28.87	24.82	-3.90	-4.74	-8.16

TABLE A51. Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

NAWCADWAR-93069-60

HUMAN SUBJECT No.: 5				SEX: Female			MODEL PREDICTIONS for SUBJECT No.: 5					
SUIT:	BAYLEY IMMERSION			WATER TEMP: 32 deg F								
TIME	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF	ABDOMEN	THIGH	CALF
min		left	left		right	left						
	(Actual temp.)			(Change in temp.)			(Estimated temp.)			(Change in temp.)		
155	31.20	25.60	23.00	-2.60	-5.40	-9.00	30.86	28.87	24.75	-3.89	-4.74	-8.23
160	31.30	25.80	23.20	-2.50	-5.20	-8.80	30.87	28.87	24.67	-3.88	-4.74	-8.31
165	31.20	26.20	23.40	-2.60	-4.80	-8.60	30.89	28.87	24.60	-3.86	-4.74	-8.38
170	31.00	26.50	23.50	-2.80	-4.50	-8.50	30.90	28.87	24.54	-3.85	-4.74	-8.44
175	30.90	26.90	23.50	-2.90	-4.10	-8.50	30.91	28.87	24.48	-3.84	-4.74	-8.50
180	30.90	27.00	23.40	-2.90	-4.00	-8.60	30.92	28.88	24.42	-3.83	-4.73	-8.56
185	31.00	27.30	23.50	-2.80	-3.70	-8.50	30.93	28.88	24.37	-3.82	-4.73	-8.61
190	31.20	27.20	23.50	-2.60	-3.80	-8.50	30.94	28.88	24.31	-3.81	-4.73	-8.67
195	31.30	27.10	23.60	-2.50	-3.90	-8.40	30.95	28.88	24.26	-3.80	-4.73	-8.72
200	31.40	27.20	23.70	-2.40	-3.80	-8.30	30.96	28.88	24.22	-3.79	-4.73	-8.76
205	31.60	28.50	23.90	-2.20	-2.50	-8.10	30.96	28.88	24.17	-3.79	-4.73	-8.81
210	31.80	28.20	24.00	-2.00	-2.80	-8.00	30.97	28.88	24.13	-3.78	-4.73	-8.85
215	31.80	27.70	23.90	-2.00	-3.30	-8.10	30.98	28.88	24.09	-3.77	-4.73	-8.89
220	31.90	27.30	23.80	-1.90	-3.70	-8.20	30.98	28.88	24.05	-3.77	-4.73	-8.93
225	31.80	27.00	23.70	-2.00	-4.00	-8.30	30.99	28.88	24.01	-3.76	-4.73	-8.97
230	31.80	27.10	23.70	-2.00	-3.90	-8.30	30.99	28.88	23.97	-3.76	-4.73	-9.01
235	31.90	27.00	23.60	-1.90	-4.00	-8.40	31.00	28.88	23.94	-3.75	-4.73	-9.04
240	32.10	26.80	23.40	-1.70	-4.20	-8.60	31.00	28.88	23.91	-3.75	-4.73	-9.07
245	32.20	26.70	23.20	-1.60	-4.30	-8.80	31.00	28.88	23.88	-3.75	-4.73	-9.10
250	32.30	26.70	23.10	-1.50	-4.30	-8.90	31.01	28.88	23.85	-3.74	-4.73	-9.13
255	32.30	26.80	23.10	-1.50	-4.20	-8.90	31.01	28.88	23.82	-3.74	-4.73	-9.16
260	32.50	26.90	23.00	-1.30	-4.10	-9.00	31.02	28.88	23.79	-3.73	-4.73	-9.19
265	32.50	26.80	23.00	-1.30	-4.20	-9.00	31.02	28.88	23.77	-3.73	-4.73	-9.21
270	32.60	26.70	22.90	-1.20	-4.30	-9.10	31.02	28.88	23.74	-3.73	-4.73	-9.24
275	32.90	26.70	22.90	-0.90	-4.30	-9.10	31.02	28.88	23.72	-3.73	-4.73	-9.26
280	33.00	26.50	23.00	-0.80	-4.50	-9.00	31.03	28.88	23.70	-3.72	-4.73	-9.28
285	32.90	26.30	23.00	-0.90	-4.70	-9.00	31.03	28.88	23.68	-3.72	-4.73	-9.30
290	33.00	26.20	23.10	-0.80	-4.80	-8.90	31.03	28.88	23.66	-3.72	-4.73	-9.32
295	33.00	26.20	23.10	-0.80	-4.80	-8.90	31.03	28.88	23.64	-3.72	-4.73	-9.34
300	33.00	26.10	23.10	-0.80	-4.90	-8.90	31.04	28.88	23.62	-3.71	-4.73	-9.36

TABLE A51 (con'd). Comparison of human abdomen, thigh and calf temperatures (degrees C) from Pelapu 4 with Model predictions. Actual temperatures and change from initial temperatures are given.

HUMAN SUBJECT 1		SEX: Male		WATER TEMP: 32 deg F		MODEL PREDICTIONS for SUBJECT No.: 1									
SUIT: GORE-TEX OVER WATER FLIGHT SUIT															
TIME	min	FOOT	CALF	THIGH	ABDOMEN	FOOT	CALF	THIGH	ABDOMEN	FOOT	CALF	THIGH	ABDOMEN	THIGH	ABDOMEN
		(left)	(left)	(right)	(right)	(left)	(left)	(right)	(right)	(left)	(left)	(right)	(right)		
		(Actual temp.)	(left)	(right)	(right)	(left)	(left)	(right)	(right)	(left)	(left)	(right)	(right)	(Change in temp.)	(Change in temp.)
0	20.80	29.70	31.00	36.40	0.00	0.00	0.00	0.00	0.00	35.42	32.79	33.41	34.51	0.00	0.00
5	18.60	28.50	29.00	35.30	-2.20	-1.20	-2.00	-1.10	-1.10	28.92	28.12	28.65	28.69	-6.50	-4.67
10	17.10	27.00	27.30	34.90	-3.70	-2.70	-3.70	-1.50	-1.50	26.67	26.61	27.28	26.66	-8.75	-6.18
15	16.10	26.20	26.30	35.00	-4.70	-3.50	-4.70	-1.40	-1.40	25.11	25.58	26.63	25.60	-10.31	-7.21
20	15.20	25.60	25.60	35.20	-5.60	-4.10	-5.40	-1.20	-1.20	23.91	24.79	26.27	24.99	-11.51	-8.00
25	14.60	25.10	25.10	35.10	-6.20	-4.60	-5.90	-1.30	-1.30	22.87	24.09	26.06	24.61	-12.55	-8.70
30	13.90	24.60	24.80	35.10	-6.90	-5.10	-6.20	-1.30	-1.30	21.98	23.49	25.94	24.39	-13.44	-9.30
35	13.40	24.20	24.60	35.10	-7.40	-5.50	-6.40	-1.30	-1.30	21.21	22.96	25.88	24.27	-14.21	-9.83
40	12.90	23.80	24.30	35.10	-7.90	-5.90	-6.70	-1.30	-1.30	20.50	22.47	25.85	24.21	-14.92	-10.32
45	12.30	23.40	24.10	35.00	-8.50	-6.30	-6.90	-1.40	-1.40	19.85	22.02	25.83	24.19	-15.57	-10.77
50	11.80	23.00	24.20	35.00	-9.00	-6.70	-6.80	-1.40	-1.40	19.28	21.62	25.82	24.20	-16.14	-11.17
55	11.50	22.80	24.20	34.90	-9.30	-6.90	-6.80	-1.50	-1.50	18.74	21.24	25.80	24.21	-16.68	-11.55
60	11.20	22.50	24.20	34.90	-9.60	-7.20	-6.80	-1.50	-1.50	18.24	20.90	25.79	24.23	-17.18	-11.89
65	10.80	22.30	24.20	34.90	-10.00	-7.40	-6.80	-1.50	-1.50	17.79	20.58	25.77	24.25	-17.63	-12.21
70	10.40	22.00	24.00	34.90	-10.40	-7.70	-7.00	-1.50	-1.50	17.37	20.29	25.75	24.26	-18.05	-12.50
75	10.30	21.80	24.00	34.80	-10.50	-7.90	-7.00	-1.60	-1.60	16.97	20.01	25.73	24.27	-18.45	-12.78
80	10.10	21.60	23.80	34.70	-10.70	-8.10	-7.20	-1.70	-1.70	16.62	19.76	25.72	24.28	-18.80	-13.03
85	9.70	21.50	23.70	34.70	-11.10	-8.20	-7.30	-1.70	-1.70	16.28	19.53	25.70	24.28	-19.14	-13.26
90	9.20	21.20	23.50	34.60	-11.60	-8.50	-7.50	-1.80	-1.80	15.97	19.31	25.68	24.28	-19.45	-13.48
95	9.00	21.00	23.30	34.50	-11.80	-8.70	-7.70	-1.90	-1.90	15.70	19.12	25.66	24.28	-19.72	-13.67
100	8.80	20.60	23.10	34.50	-12.00	-9.10	-7.90	-1.90	-1.90	15.43	18.93	25.64	24.28	-19.99	-13.86
105	8.80	20.60	23.10	34.40	-12.00	-9.10	-7.90	-2.00	-2.00	15.19	18.76	25.62	24.28	-20.23	-14.03

TABLE A52. Comparison of human foot, calf, thigh and abdomen temperatures (degrees C) from Pelapu 5 with Model predictions. Actual temperatures and change from initial temperatures are given.

HUMAN SUBJECT 2		SEX: Male		WATER TEMP: 32 deg F		MODEL PREDICTIONS for SUBJECT No.: 2											
SUIT: GORE-TEX OVER WATER FLIGHT SUIT																	
TIME		FOOT (left)	CALF (left)	THIGH (left)	ABDOMEN (left)	FOOT (left)	CALF (left)	THIGH (left)	ABDOMEN (left)	FOOT (right)	CALF (right)	THIGH (right)	ABDOMEN (right)	FOOT (right)	CALF (right)	THIGH (right)	ABDOMEN (right)
min		(Actual temp.)		(Change in temp.)		(Estimated temp.)		(Change in temp.)									
0	21.80	32.60	31.90	34.20	0.00	0.00	0.00	0.00	0.00	35.44	32.80	33.42	34.52	0.00	0.00	0.00	0.00
5	21.50	32.60	32.00	34.50	-0.30	0.00	0.10	0.30		28.87	27.82	28.23	28.59	-6.57	-4.98	-5.19	-5.93
10	18.80	30.00	28.90	33.20	-3.00	-2.60	-3.00	-1.00		26.62	26.27	26.73	26.37	-8.82	-6.53	-6.69	-8.15
15	17.30	28.80	27.20	31.90	-4.50	-3.80	-4.70	-2.30		25.06	25.22	25.91	25.13	-10.38	-7.58	-7.51	-9.39
20	16.50	27.90	26.10	31.20	-5.30	-4.70	-5.80	-3.00		23.86	24.41	25.41	24.37	-11.58	-8.39	-8.01	-10.15
25	15.70	27.10	25.30	30.80	-6.10	-5.50	-6.60	-3.40		22.83	23.72	25.08	23.85	-12.61	-9.08	-8.34	-10.67
30	15.00	26.30	24.50	30.50	-6.80	-6.30	-7.40	-3.70		21.94	23.12	24.86	23.50	-13.50	-9.68	-8.56	-11.02
35	14.40	25.70	24.10	30.30	-7.40	-6.90	-7.80	-3.90		21.18	22.59	24.73	23.28	-14.26	-10.21	-8.69	-11.24
40	13.90	25.20	23.60	29.80	-7.90	-7.40	-8.30	-4.40		20.47	22.10	24.64	23.13	-14.97	-10.70	-8.78	-11.39
45	13.40	24.70	23.10	29.70	-8.40	-7.90	-8.80	-4.50		19.83	21.65	24.59	23.04	-15.61	-11.15	-8.83	-11.48
50	12.90	24.30	22.70	29.20	-8.90	-8.30	-9.20	-5.00		19.26	21.25	24.55	22.99	-16.18	-11.55	-8.87	-11.53
55	12.50	24.00	22.30	28.30	-9.30	-8.60	-9.60	-5.90		18.72	20.87	24.53	22.97	-16.72	-11.93	-8.89	-11.55
60	12.10	23.70	22.10	27.40	-9.70	-8.90	-9.80	-6.80		18.22	20.51	24.51	22.97	-17.22	-12.29	-8.91	-11.55
65	11.70	23.50	21.80	26.70	-10.10	-9.10	-10.10	-7.50		17.77	20.19	24.50	22.98	-17.67	-12.61	-8.92	-11.54
70	11.30	23.20	21.60	26.10	-10.50	-9.40	-10.30	-8.10		17.34	19.88	24.48	22.99	-18.10	-12.92	-8.94	-11.53
75	11.00	23.00	21.40	25.60	-10.80	-9.60	-10.50	-8.60		16.94	19.60	24.46	23.00	-18.50	-13.20	-8.96	-11.52
80	10.80	22.60	21.20	25.10	-11.00	-10.00	-10.70	-9.10		16.57	19.34	24.45	23.01	-18.87	-13.46	-8.97	-11.51
85	10.60	22.00	20.80	24.90	-11.20	-10.60	-11.10	-9.30		16.22	19.09	24.43	23.02	-19.22	-13.71	-8.99	-11.50
90	10.30	21.80	20.50	24.70	-11.50	-10.80	-11.40	-9.50		15.90	18.85	24.41	23.03	-19.54	-13.95	-9.01	-11.49
95	10.10	21.50	20.40	24.40	-11.70	-11.10	-11.50	-9.80		15.60	18.64	24.39	23.03	-19.84	-14.16	-9.03	-11.49

TABLE A53. Comparison of human foot, calf, thigh and abdomen temperatures (degrees C) from Pelapu 5 with Model predictions. Actual temperatures and change from initial temperatures are given.

HUMAN SUBJECT 3			SEX: Male		WATER TEMP: 32 deg F				MODEL PREDICTIONS for SUBJECT No.: 3											
SUIT: GORE-TEX OVER WATER FLIGHT SUIT																				
TIME	FOOT (left)	CALF (left)	THIGH (right)	ABDOMEN (left)	FOOT (left)	CALF (left)	THIGH (right)	ABDOMEN (right)	FOOT	CALF	THIGH	ABDOMEN	FOOT	CALF	THIGH	ABDOMEN	FOOT	CALF	THIGH	ABDOMEN
min	(Actual temp.)				(Change in temp.)				(Estimated temp.)				(Change in temp.)							
0	21.30	30.50	32.50	33.40	0.00	0.00	0.00	0.00	35.43	32.80	33.42	34.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	19.20	28.30	28.70	30.40	-2.10	-2.20	-3.80	-3.00	28.88	27.92	28.37	28.61	-6.55	-4.88	-5.05	-5.91				
10	18.10	27.00	27.10	28.90	-3.20	-3.50	-5.40	-4.50	26.63	26.39	26.91	26.46	-8.80	-6.41	-6.51	-8.06				
15	17.20	26.00	26.20	27.90	-4.10	-4.50	-6.30	-5.50	25.08	25.35	26.15	25.29	-10.35	-7.45	-7.27	-9.23				
20	16.30	25.00	25.20	27.10	-5.00	-5.50	-7.30	-6.30	23.87	24.54	25.70	24.58	-11.56	-8.26	-7.72	-9.94				
25	15.60	24.40	24.40	26.50	-5.70	-6.10	-8.10	-6.90	22.84	23.85	25.42	24.11	-12.59	-8.95	-8.00	-10.41				
30	14.80	23.70	23.80	25.80	-6.50	-6.80	-8.70	-7.60	21.95	23.25	25.25	23.81	-13.48	-9.55	-8.17	-10.71				
35	14.20	23.00	23.20	25.40	-7.10	-7.50	-9.30	-8.00	21.18	22.72	25.15	23.63	-14.25	-10.08	-8.27	-10.89				
40	13.60	22.50	22.60	25.00	-7.70	-8.00	-9.90	-8.40	20.48	22.23	25.08	23.52	-14.95	-10.57	-8.34	-11.00				
45	13.00	21.80	22.10	24.80	-8.30	-8.70	-10.40	-8.60	19.84	21.78	25.04	23.46	-15.59	-11.02	-8.38	-11.06				
50	12.50	21.70	21.90	24.80	-8.80	-8.80	-10.60	-8.60	19.26	21.38	25.02	23.43	-16.17	-11.42	-8.40	-11.09				
55	12.10	21.60	21.80	25.40	-9.20	-8.90	-10.70	-8.00	18.72	21.00	25.00	23.43	-16.71	-11.80	-8.42	-11.09				
60	11.70	21.30	21.80	25.80	-9.60	-9.20	-10.70	-7.60	18.22	20.65	24.99	23.44	-17.21	-12.15	-8.43	-11.08				
65	11.80	20.80	21.90	25.60	-9.50	-9.70	-10.60	-7.80	17.77	20.33	24.97	23.45	-17.66	-12.47	-8.45	-11.07				
70	11.30	20.40	21.70	25.70	-10.00	-10.10	-10.80	-7.70	17.34	20.02	24.96	23.46	-18.09	-12.78	-8.46	-11.06				

TABLE A54. Comparison of human foot, calf, thigh and abdomen temperatures (degrees C) from Pelepu 5 with Model predictions. Actual temperatures and change from initial temperatures are given.

HUMAN SUBJECT 4				SEX: Male		WATER TEMP: 32 deg F		MODEL PREDICTIONS for SUBJECT No.: 4								
SUIT: GORE-TEX OVER WATER FLIGHT SUIT																
TIME	FOOT		CALF		THIGH		ABDOMEN		FOOT		CALF		THIGH		ABDOMEN	
	(left)	(right)	(left)	(right)	(left)	(right)	(left)	(right)	(left)	(right)	(left)	(right)	(left)	(right)	(left)	(right)
min	(Actual temp.)		(Change in temp.)		(Change in temp.)		(Change in temp.)		(Estimated temp.)		(Change in temp.)		(Estimated temp.)		(Change in temp.)	
0	20.70	31.40	33.60	35.80	0.00	0.00	0.00	0.00	35.42	32.81	33.43	34.52	0.00	0.00	0.00	0.00
5	19.50	30.80	32.10	34.20	-1.20	-0.60	-1.50	-1.60	28.73	28.54	29.50	29.01	-6.69	-6.27	-3.93	-5.51
10	20.20	28.90	29.50	32.70	-0.50	-2.50	-4.10	-3.10	26.49	27.08	28.16	27.13	-8.93	-5.73	-5.27	-7.39
15	20.10	28.40	28.90	31.20	-0.60	-3.00	-4.70	-4.60	24.94	26.05	27.54	26.15	-10.48	-6.76	-5.89	-8.37
20	18.20	27.70	27.80	30.70	-2.50	-3.70	-5.80	-5.10	23.75	25.25	27.20	25.57	-11.67	-7.56	-6.23	-8.95
25	16.90	26.40	26.70	29.00	-3.80	-5.00	-6.90	-6.80	22.73	24.56	27.01	25.21	-12.69	-8.25	-6.42	-9.31
30	16.20	26.40	26.50	30.10	-4.50	-5.00	-7.10	-5.70	21.84	23.95	26.92	25.00	-13.58	-8.86	-6.51	-9.52
35	15.80	25.40	25.50	30.10	-4.90	-6.00	-8.10	-5.70	21.08	23.41	26.88	24.90	-14.34	-9.40	-6.55	-9.62
40	15.20	24.90	24.70	29.70	-5.50	-6.50	-8.90	-6.10	20.38	22.92	26.86	24.87	-15.04	-9.89	-6.57	-9.65
45	14.30	24.70	24.50	31.40	-6.40	-6.70	-9.10	-4.40	19.74	22.46	26.85	24.87	-15.68	-10.35	-6.58	-9.65
50	13.70	24.20	23.90	30.80	-7.00	-7.20	-9.70	-5.00	19.17	22.05	26.85	24.89	-16.25	-10.76	-6.58	-9.63
55	13.00	23.70	23.50	31.40	-7.70	-7.70	-10.10	-4.40	18.63	21.67	26.84	24.92	-16.79	-11.14	-6.59	-9.60
60	12.50	23.30	23.10	31.40	-8.20	-8.10	-10.50	-4.40	18.13	21.31	26.83	24.95	-17.29	-11.50	-6.60	-9.57
65	12.30	23.20	23.00	31.80	-8.40	-8.20	-10.60	-4.00	17.68	20.98	26.81	24.97	-17.74	-11.83	-6.62	-9.55
70	11.80	23.20	22.70	30.80	-8.90	-8.20	-10.90	-5.00	17.25	20.68	26.79	24.99	-18.17	-12.13	-6.64	-9.53
75	11.50	22.80	22.30	32.10	-9.20	-8.60	-11.30	-3.70	16.86	20.39	26.77	25.01	-18.56	-12.42	-6.66	-9.51
80	10.80	22.50	22.10	31.50	-9.90	-8.90	-11.50	-4.30	16.50	20.13	26.74	25.02	-18.92	-12.68	-6.69	-9.50

TABLE A55. Comparison of human foot, calf, thigh and abdomen temperatures (degrees C) from Pelapu 5 with Model predictions. Actual temperatures and change from initial temperatures are given.

HUMAN SUBJECT 5		SEX: Male		WATER TEMP: 32 deg F		MODEL PREDICTIONS for SUBJECT No.: 5							
SUIT: GORE-TEX OVER WATER FLIGHT SUIT													
TIME	min	FOOT (left)	CALF (left)	THIGH (left)	ABDOMEN (left)	FOOT (left)	CALF (left)	THIGH (left)	ABDOMEN (left)	FOOT (left)	CALF (left)	THIGH (left)	ABDOMEN (left)
		(Actual temp.)	(left)	(right)	(right)	(left)	(left)	(left)	(right)	(left)	(left)	(left)	(right)
		(Change in temp.)	(Change in temp.)	(Change in temp.)	(Change in temp.)	(Estimated temp.)	(Estimated temp.)	(Estimated temp.)	(Estimated temp.)	(Estimated temp.)	(Estimated temp.)	(Estimated temp.)	(Estimated temp.)
0	20.70	31.90	31.90	33.00	0.00	0.00	0.00	0.00	0.00	35.44	32.80	33.43	34.53
5	18.20	30.00	28.70	31.60	-2.50	-1.90	-3.20	-1.40	-1.40	28.91	27.93	28.36	28.63
10	16.70	28.60	26.90	30.80	-4.00	-3.30	-5.00	-2.20	-2.20	26.65	26.40	26.88	26.45
15	15.60	27.60	25.70	30.30	-5.10	-4.30	-6.20	-2.70	-2.70	25.09	25.35	26.08	25.24
20	14.70	26.80	25.00	30.20	-6.00	-5.10	-6.90	-2.80	-2.80	23.89	24.55	25.58	24.49
25	14.00	26.10	24.30	30.10	-6.70	-5.80	-7.60	-2.90	-2.90	22.86	23.85	25.25	23.98
30	13.20	25.40	23.70	29.90	-7.50	-6.50	-8.20	-3.10	-3.10	21.97	23.25	25.04	23.64
35	12.60	24.80	23.20	29.70	-8.10	-7.10	-8.70	-3.30	-3.30	21.20	22.72	24.91	23.41
40	12.00	24.30	22.80	29.50	-8.70	-7.60	-9.10	-3.50	-3.50	20.49	22.23	24.83	23.27
45	11.60	23.80	22.50	29.20	-9.10	-8.10	-9.40	-3.80	-3.80	19.85	21.78	24.78	23.19
50	11.20	23.40	22.30	29.10	-9.50	-8.50	-9.60	-3.90	-3.90	19.28	21.37	24.75	23.14
55	10.80	22.90	22.10	29.10	-9.90	-9.00	-9.80	-3.90	-3.90	18.74	20.99	24.72	23.13
60	10.40	22.50	22.00	29.00	-10.30	-9.40	-9.90	-4.00	-4.00	18.24	20.63	24.71	23.13
65	10.10	22.10	21.80	29.10	-10.60	-9.80	-10.10	-3.90	-3.90	17.78	20.31	24.69	23.13
70	9.80	21.80	21.70	28.90	-10.90	-10.10	-10.20	-4.10	-4.10	17.35	19.99	24.68	23.15
75	9.50	21.50	21.80	29.00	-11.20	-10.40	-10.10	-4.00	-4.00	16.95	19.70	24.66	23.16
80	9.30	21.10	21.80	28.90	-11.40	-10.80	-10.10	-4.10	-4.10	16.58	19.44	24.64	23.17
85	9.00	20.80	22.00	29.00	-11.70	-11.10	-9.90	-4.00	-4.00	16.23	19.19	24.62	23.18
90	8.80	20.50	22.20	28.90	-11.90	-11.40	-9.70	-4.10	-4.10	15.90	18.95	24.61	23.19
95	8.60	20.30	22.40	29.00	-12.10	-11.60	-9.50	-4.00	-4.00	15.60	18.73	24.59	23.20
100	8.40	20.00	22.30	29.00	-12.30	-11.90	-9.60	-4.00	-4.00	15.32	18.53	24.57	23.20
105	8.30	19.80	22.40	29.10	-12.40	-12.10	-9.50	-3.90	-3.90	15.05	18.33	24.55	23.20

TABLE A56. Comparison of human foot, calf, thigh and abdomen temperatures (degrees C) from Pelapu 5 with Model predictions. Actual temperatures and change from initial temperatures are given.

HUMAN SUBJECT 6		SEX: Male		WATER TEMP: 32 deg F		MODEL PREDICTIONS for SUBJECT No.: 6											
SUIT: GORE-TEX OVER WATER FLIGHT SUIT																	
TIME		FOOT	CALF	THIGH	ABDOMEN	FOOT	CALF	THIGH	ABDOMEN	FOOT	CALF	THIGH	ABDOMEN	FOOT	CALF	THIGH	ABDOMEN
		(left)	(left)	(right)	(left)	(left)	(left)	(left)	(right)								
min		(Actual temp.)		(Change in temp.)		(left)		(right)		(Estimated temp.)		(Change in temp.)		(left)		(Change in temp.)	
0	24.00	31.80	32.40	34.70	0.00	0.00	0.00	0.00	0.00	35.43	32.83	33.45	34.53	0.00	0.00	0.00	0.00
5	21.80	30.00	30.20	32.40	-2.20	-1.80	-2.20	-2.30	-2.30	28.74	28.75	29.89	29.20	-6.69	-4.08	-3.56	-5.33
10	20.50	28.90	28.90	30.90	-3.50	-2.90	-3.50	-3.80	-3.80	26.49	27.30	28.52	27.36	-8.94	-5.53	-4.93	-7.17
15	19.40	28.10	28.10	30.40	-4.60	-3.70	-4.30	-4.30	-4.30	24.94	26.27	27.88	26.38	-10.49	-6.56	-5.57	-8.15
20	18.50	27.40	27.40	29.90	-5.50	-4.40	-5.00	-4.80	-4.80	23.75	25.47	27.52	25.79	-11.68	-7.36	-5.93	-8.74
25	17.60	26.80	26.80	29.70	-6.40	-5.00	-5.60	-5.00	-5.00	22.73	24.77	27.32	25.41	-12.70	-8.06	-6.13	-9.12
30	16.80	26.20	26.40	29.70	-7.20	-5.60	-6.00	-5.00	-5.00	21.84	24.16	27.22	25.19	-13.59	-8.67	-6.23	-9.34
35	16.00	25.80	26.00	29.50	-8.00	-6.00	-6.40	-5.20	-5.20	21.08	23.62	27.18	25.08	-14.35	-9.21	-6.27	-9.45
40	15.30	25.20	25.80	29.30	-8.70	-6.60	-6.60	-5.40	-5.40	20.38	23.12	27.16	25.04	-15.05	-9.71	-6.29	-9.49
45	14.80	24.70	25.40	29.40	-9.20	-7.10	-7.00	-5.30	-5.30	19.74	22.66	27.16	25.04	-15.69	-10.17	-6.29	-9.49
50	14.20	24.20	25.30	29.40	-9.80	-7.60	-7.10	-5.30	-5.30	19.17	22.25	27.15	25.07	-16.26	-10.58	-6.30	-9.46
55	13.60	21.80	25.30	29.50	-10.40	-10.00	-7.10	-5.20	-5.20	18.63	21.85	27.15	25.10	-16.80	-10.98	-6.30	-9.43
60	13.00	23.40	25.30	29.60	-11.00	-8.40	-7.10	-5.10	-5.10	18.13	21.49	27.14	25.14	-17.30	-11.34	-6.31	-9.39
65	12.60	22.90	25.60	29.70	-11.40	-8.90	-6.80	-5.00	-5.00	17.68	21.15	27.12	25.17	-17.75	-11.68	-6.33	-9.36
70	12.20	22.50	25.60	29.80	-11.80	-9.30	-6.80	-4.90	-4.90	17.25	20.84	27.10	25.19	-18.18	-11.99	-6.35	-9.34
75	11.80	22.20	25.50	29.80	-12.20	-9.60	-6.90	-4.90	-4.90	16.85	20.54	27.08	25.21	-18.58	-12.29	-6.37	-9.32
80	11.40	22.00	25.20	29.90	-12.60	-9.80	-7.20	-4.80	-4.80	16.48	20.27	27.05	25.22	-18.95	-12.56	-6.40	-9.31
85	11.10	21.80	25.60	29.40	-12.90	-10.00	-6.80	-5.30	-5.30	16.13	20.01	27.03	25.23	-19.30	-12.82	-6.42	-9.30
90	10.70	21.40	25.70	29.30	-13.30	-10.40	-6.70	-5.40	-5.40	15.81	19.77	27.00	25.23	-19.62	-13.06	-6.45	-9.30
95	10.50	21.10	25.70	29.40	-13.50	-10.70	-6.70	-5.30	-5.30	15.51	19.55	26.97	25.23	-19.92	-13.28	-6.48	-9.30
100	10.20	20.90	26.50	29.40	-13.80	-10.90	-5.90	-5.30	-5.30	15.23	19.34	26.94	25.22	-20.20	-13.49	-6.51	-9.31
105	10.00	20.60	26.90	29.20	-14.00	-11.20	-5.50	-5.50	-5.50	14.97	19.15	26.92	25.21	-20.46	-13.68	-6.53	-9.32
110	9.70	20.30	26.60	28.90	-14.30	-11.50	-5.80	-5.80	-5.80	14.73	18.97	26.89	25.20	-20.70	-13.86	-6.56	-9.33
115	9.40	20.00	27.00	28.80	-14.60	-11.80	-5.40	-5.90	-5.90	14.50	18.80	26.86	25.19	-20.93	-14.03	-6.59	-9.34
120	9.30	19.70	28.00	28.90	-14.70	-12.10	-4.40	-5.80	-5.80	14.29	18.64	26.83	25.17	-21.14	-14.19	-6.62	-9.36

TABLE A57. Comparison of human foot, calf, thigh and abdomen temperatures (degrees C) from Pelapu 5 with Model predictions. Actual temperatures and change from initial temperatures are given.

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